NORTH DAKOTA STATE AGENCY
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SIXTH BIENNIAL REPORT

of the

State Water Conservation Commission

and the

TWENTY-THIRD BIENNIAL REPORT

of the

STATE ENGINEER

of

North Dakota

From October 1, 1946 to October 1, 1948

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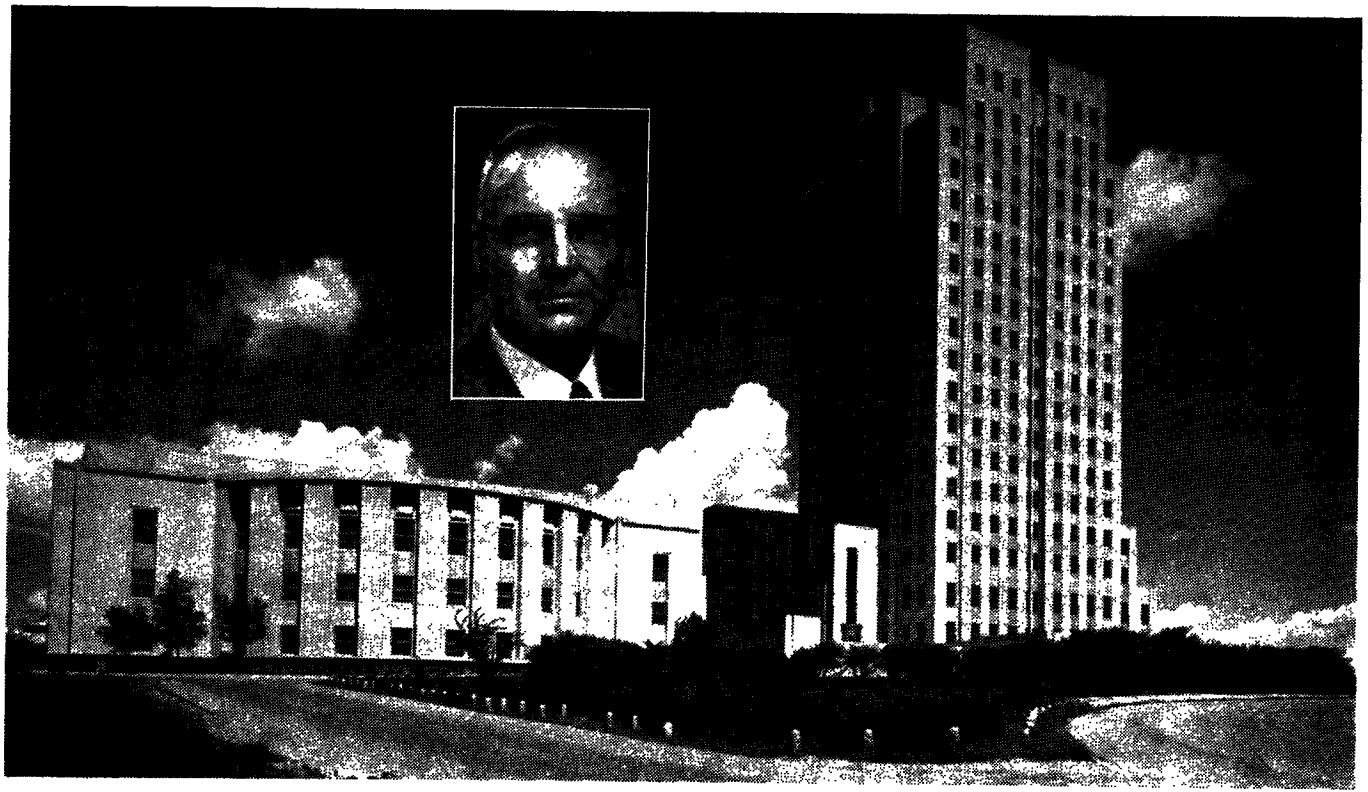


North Dakota's State Capitol. Insert: Governor Fred G. Aandahl

LETTER OF TRANSMITTAL

November 1, 1948

Honorable Fred G. Aandahl
Governor of North Dakota

Sir:

In compliance with provisions of law, we transmit herewith for your information and consideration the Sixth Biennial Report of the activities of the State Water Conservation Commission and the Twenty-third Biennial Report of the State Engineer, from October 1, 1946, to October 1, 1948.

Respectfully submitted,

STATE WATER CONSERVATION COMMISSION

S. W. THOMPSON, Vice Chairman
EINAR H. DAHL
CURTIS OLSON
EARLE F. TUCKER

J. J. Walsh
Secretary and Chief Engineer, State Engineer

WISE FOREFATHERS

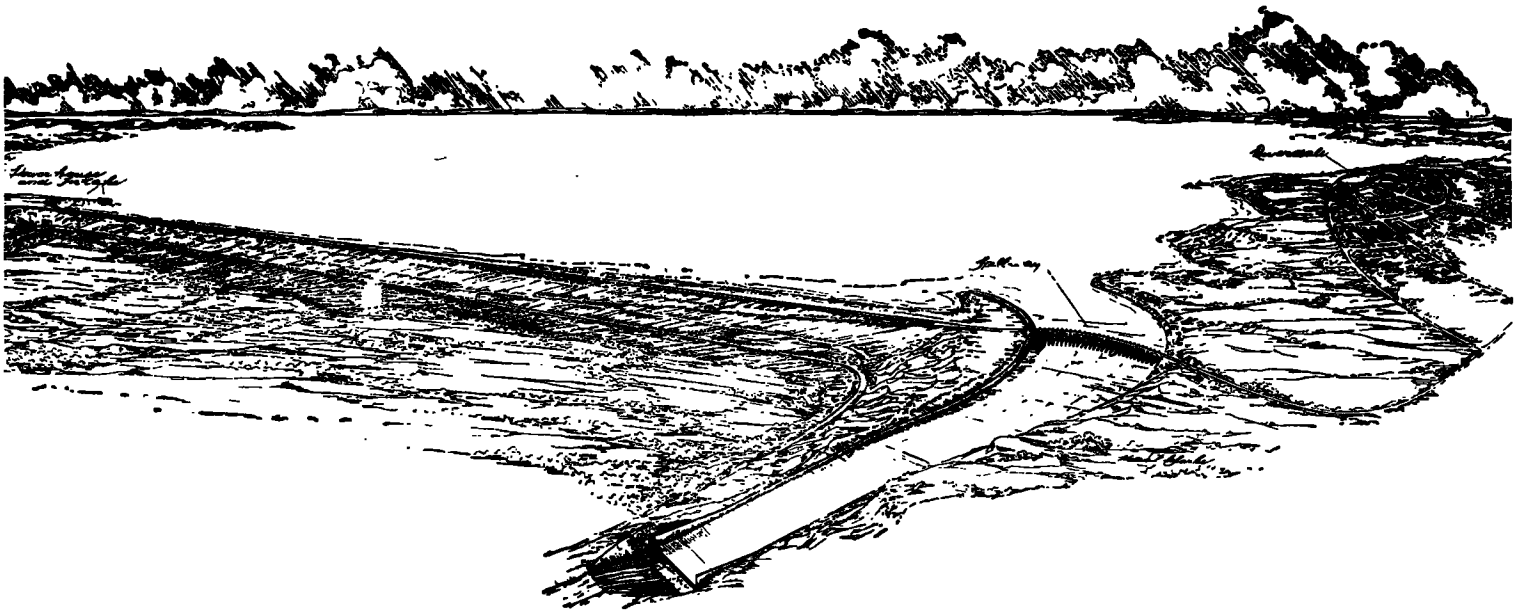
"Let us develop the resources of our land, call forth its powers, build up its institutions, promote all its great interests, and see whether we also in our day and generation may not perform something worthy to be remembered."—Daniel Webster.

NORTH DAKOTA CONSTITUTION:

"Sec. 210—"All flowing streams and natural water courses shall forever remain the property of the state for mining, irrigation and manufacturing purposes."

USES OF WATER

"It is the right for the National Government to make the streams and rivers of the arid region useful by engineering works for the storage of water, as to make useful the rivers and harbors of the humid regions by engineering works of another character."—Theodore Roosevelt.



Garrison Dam and Reservoir Sketch

ORGANIZATION AND PERSONNEL

The State Water Conservation Commission was created by the 1937 legislature. The Governor was made ex-officio Chairman and authorized to appoint the other members. Amendments to the law were made by the 1939 legislature and later sessions.

Membership:

	Term began	Term ends
Governor Fred G. Aandahl, ex-officio chairman	Jan. 2, 1945	
Sivert W. Thompson, vice-chairman	Apr. 3, 1941	June 30, 1953
Einar H. Dahl	Apr. 3, 1941	June 30, 1953
Curtis Olson	Jan. 1, 1948	June 30, 1951
Earle F. Tucker	May 1, 1948	July 1, 1949

J. J. Walsh, Secretary and Chief Engineer, State Engineer.

Two members of the Water Commission passed away during the biennium 1947-1949. Lewis T. Orlady of Jamestown died on December 5, 1947, and Kenneth W. Simons, Bismarck, on April 19, 1948. Both had been zealous in their support of the water and power development plan for North Dakota and gave generously and freely of their time in promoting water conservation to make North Dakota a better place in which to live. Kenneth W. Simons had been a member since the organization of the Commission and was its Vice-Chairman. Curtis Olson of Valley City was appointed to succeed Mr. Orlady, and Earle F. Tucker to succeed Mr. Simons. Sivert W. Thompson was elected as Vice-Chairman to fill the vacancy after the death of Mr. Simons.

POWERS AND DUTIES, STATE WATER COMMISSION

Powers and Duties of the Commission. The commission shall have full and complete power, authority, and general jurisdiction:

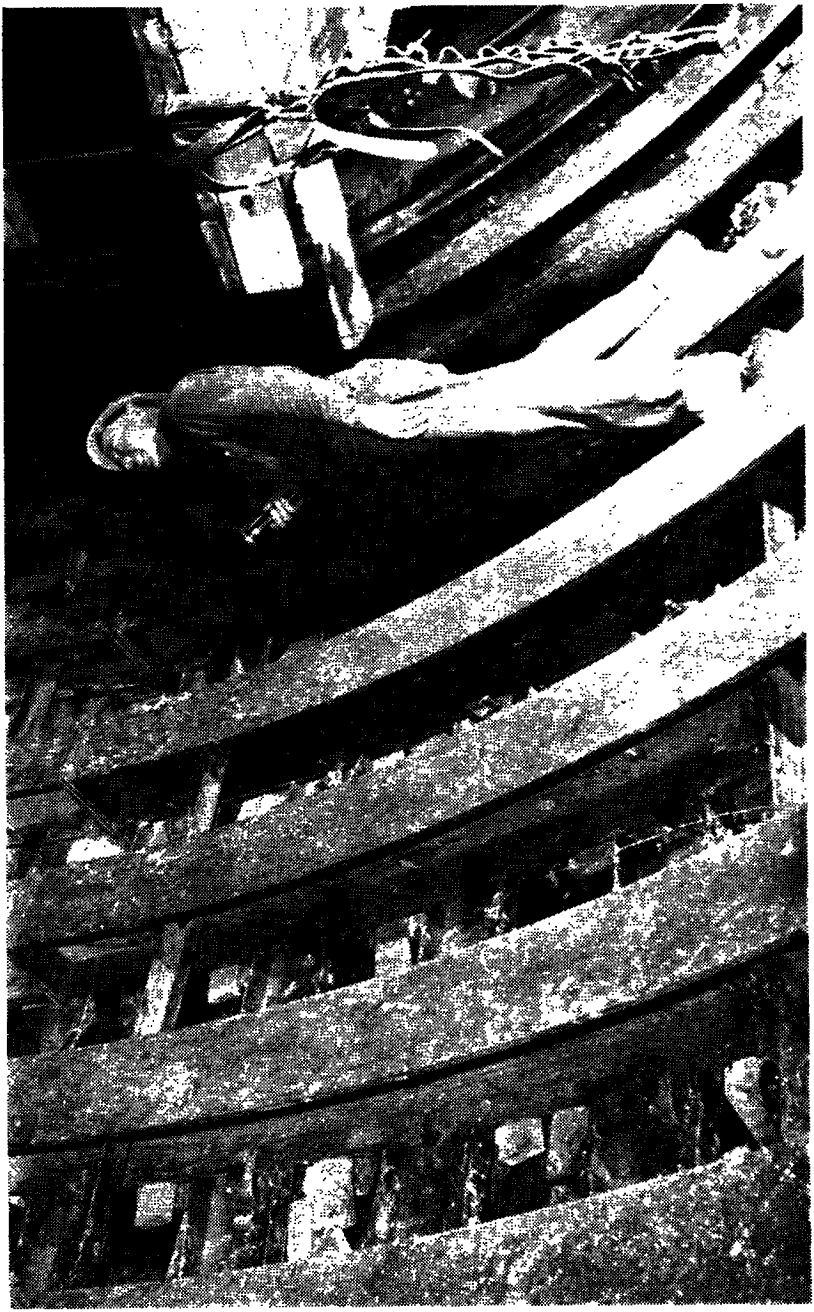
1. To investigate, plan, regulate, undertake, construct, establish, maintain, control, and supervise all works, dams, and projects, public and private, which in its judgment may be necessary or advisable:

a. To control the low-water flow of streams in the state;

b. To impound water for the improvement of municipal and rural water supplies;

c. To control and regulate flood flow in the streams of the state to minimize the damage of such flood waters;

d. To conserve and develop the waters within the natural water-shed areas of the state and, subject to vested and riparian rights, to divert the waters within water-shed area to another water-shed area and the waters of any river, lake or stream into another river, lake or stream.



Inside Immense 36 ft. Diameter River Diversion Tunnels at the Garrison Dam

e. To improve the channels of the streams for more efficient transportation of the available water in the streams;

f. To provide sufficient water flow for the abatement of stream pollution;

g. To develop, restore and stabilize the waters of the state for domestic, agricultural and municipal needs, irrigation, flood control, recreation, and wildlife conservation, by the construction and maintenance of dams, reservoirs and diversion canals;

h. To promote the maintenance of existing drainage channels in good agricultural lands and to construct any needed channels;

i. To provide more satisfactory subsurface water supplies for the smaller villages of the state;

j. To finance the construction, establishment, and maintenance of public and private works, dams, and irrigation projects, which in its judgment may be necessary and advisable;

k. To provide for the storage, development, diversion, delivery, and distribution of water for the irrigation of agricultural land;

l. To provide for the drainage of lands injured by or susceptible of injury from excessive rainfall or from the utilization of irrigation water and, subject to the limitations prescribed by law, to aid and cooperate with the United States and any department, agency, or officer thereof, and with any county, township, drainage district or irrigation district of this state, or of other states, in the construction or improvement of such drains;

m. To provide water for stock; and

n. To provide water for the generation of electric power and for mining and manufacturing purposes;

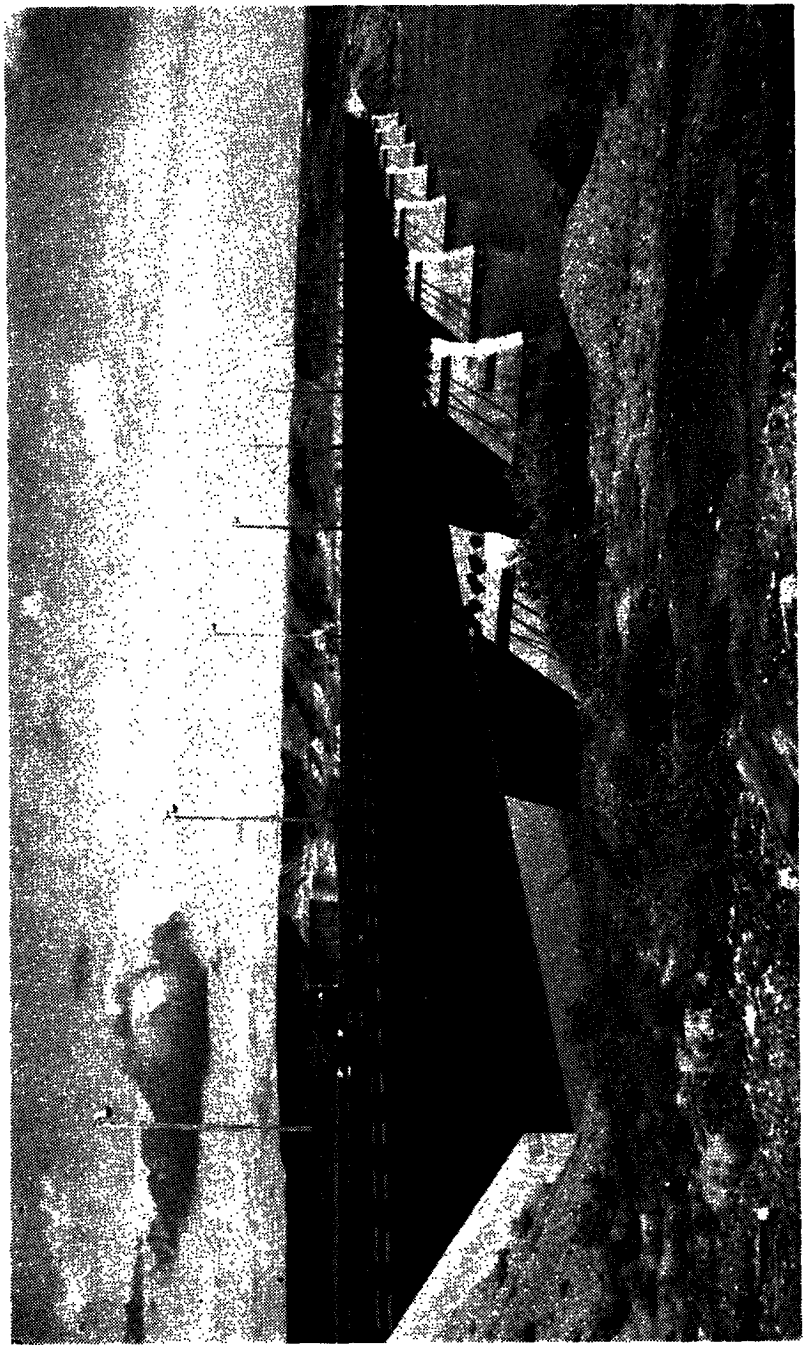
2. To define, declare, and establish rules and regulations:

a. For the sale of waters and water rights to individuals, associations, corporations, and political subdivisions of the state, and for the delivery of water to users;

b. For the full and complete supervision, regulation, and control of the water supplies within the state; and

c. For the complete supervision and control of acts tending to pollute watercourses, for the protection of the health and safety of all the people of the state;

3. To exercise full power and control of the construction, operation, and maintenance of works and the collection of rates, charges, and revenues realized therefrom;



Garrison Dam Construction Bridge carries foot passengers, trucks and trains, and from which Trainloads of rock will be dumped to close river channel

4. To sell, lease, and otherwise distribute all waters which may be developed, impounded, and diverted by the commission under the provisions of this chapter, for the purpose of irrigation, the development of power, and the watering of livestock, and for any other private or public use; and

5. To exercise all express and implied rights, power, and authority, that may be necessary, and to do, perform, and carry out all of the expressed purposes of this chapter and all of the purposes reasonably implied incidentally thereto or lawfully connected therewith.

6. To acquire, own and develop lands for irrigation and water conservation and to acquire, own and develop dam sites and reservoir sites and to acquire easements and rights-of-way for diversion and distributing canals.

7. To cooperate with the United States and any department, agency or officer thereof in the planning, establishment and maintenance of dams, reservoirs, diversion and distributing canals, for the utilization of the waters of the state for domestic and municipal needs, irrigation, flood control, water conservation, generation of electric power and for mining, agricultural and manufacturing purposes, and in this connection the State Water Conservation Commission is hereby authorized, within the limitations prescribed by law, to acquire, convey, contribute or grant to the United States real and personal property, including land or easements for dams and reservoir sites and rights-of-way and easements for diversion and distribution canals.

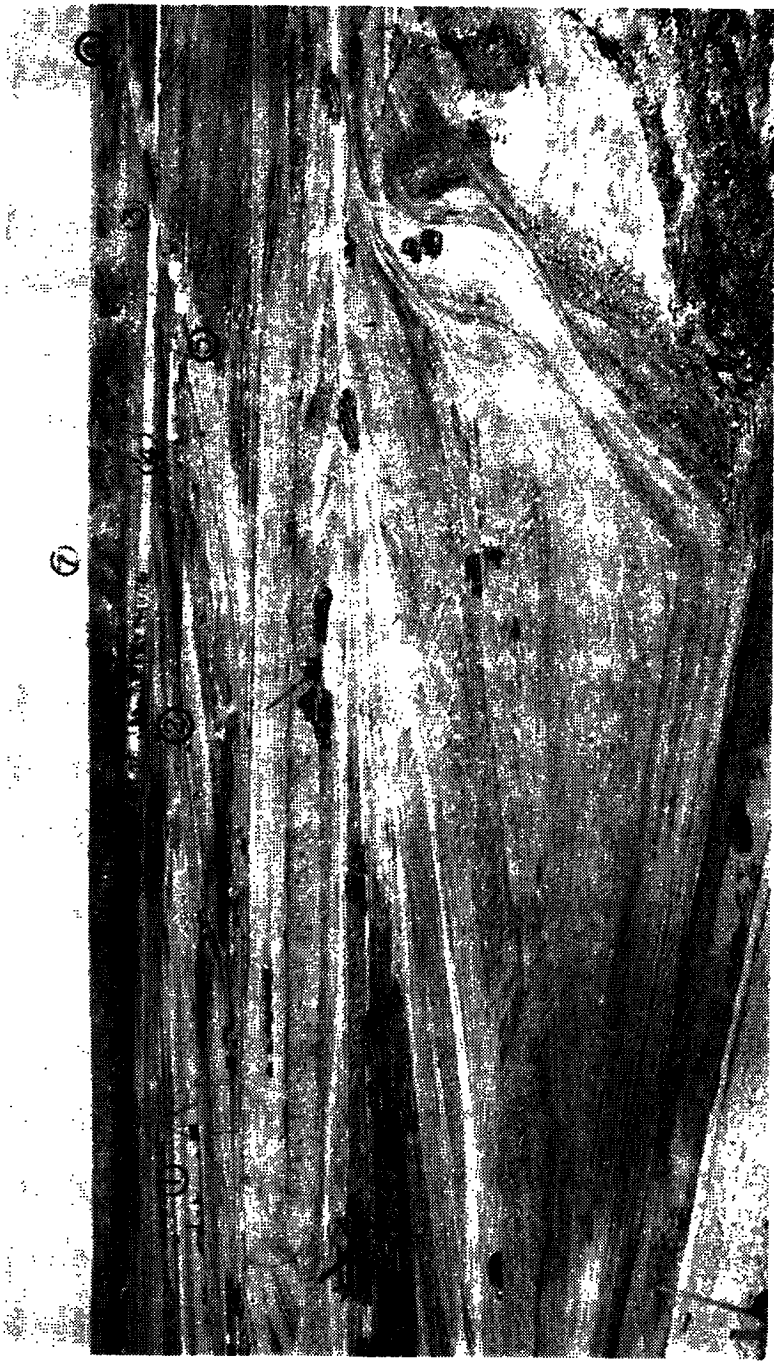
THE STATE ENGINEER

The State Water Conservation Commission appoints the State Engineer, who shall be a qualified and experienced hydraulic engineer and also shall be an experienced irrigation engineer. He shall serve as secretary and chief engineer of the commission.

He is required to make a formal printed report to the Governor for the biennium preceding each legislative session. He passes on applications for permits to appropriate water, records the permit when granted, and issues certificate of construction of irrigation works or dams when completed, examines and approves plans and specifications for dams or irrigation works, inspects dam sites and construction works, and collects state fees for same as required by law.

His records are open to public inspection during business hours. He is the custodian of General Land office maps, field notes and records of surveys of land turned over by the government to the state.

He shall make such rules and regulations necessary to carry into effect the duties devolving upon his office, relating to applications for permits to appropriate water, for the inspection of works, for the issuance of licenses, and for the determination of rights to the use of water.



Air View Garrison Dam Embankment, looking east. 1—Pile Driving. 2—Embankment. 3—Construction Bridge. 4—Missouri River. 5—Repair Shops. 6—Bridge Approach. 7—Riverdale

He cooperates with Federal agencies in making hydrographic surveys and investigation of each stream system and source of water supply in the state, and shall obtain and record all available data for the determination, development and adjudication of the water supply of the state, and other duties pertaining thereto.

He cooperates with the U. S. Geological Survey in making topographic maps and surveys.

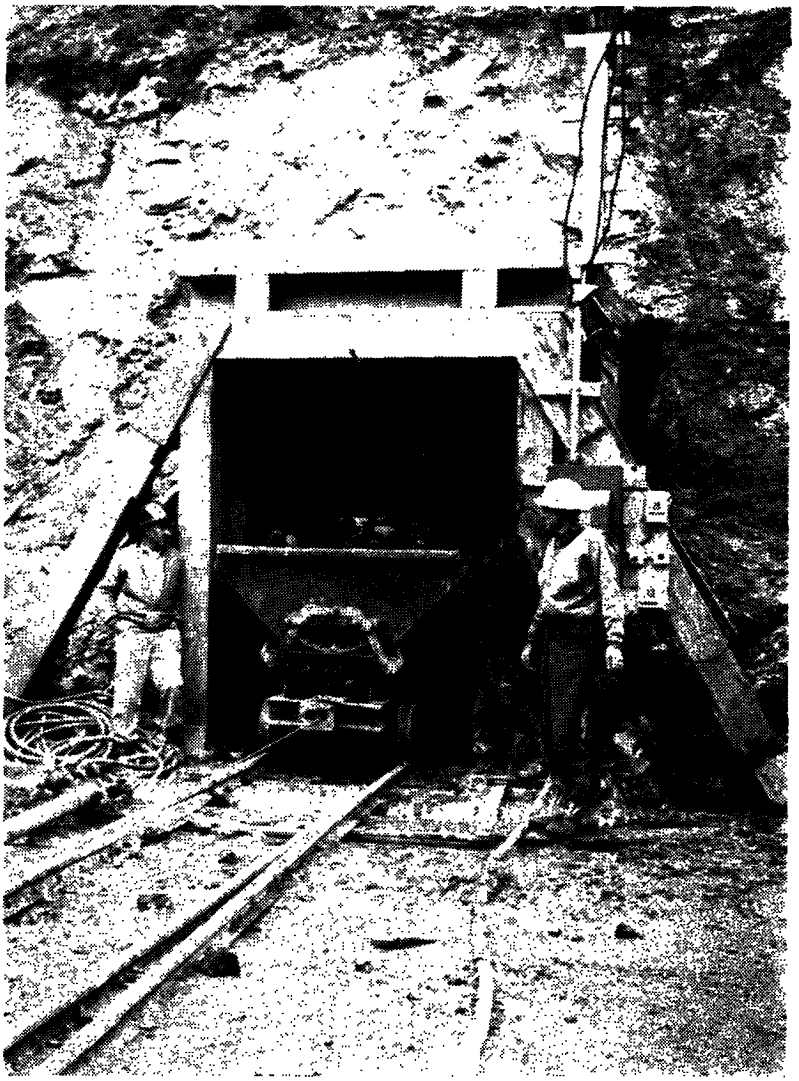
THE BUREAU OF RECLAMATION

The North Dakota State Water Conservation Commission water and power resources development plan provides for the ultimate construction of the coordinated plan of the Bureau of Reclamation and the Corps of Engineers, as published in Senate Document No. 191, Bureau of Reclamation report, and House Document No. 475, report of the Corps of Engineers, which was finally approved by the two Federal agencies and coordinated in Senate Document No. 247 and enacted into Public Law No. 534, and approved by the Congress September 22, 1944. This plan of development is more clearly detailed in the above reports.

The Bureau of Reclamation and the Corps of Engineers' plan is as follows:

The Bureau of Reclamation plan as, shown in Senate Document No. 191, provides for the development of irrigation, conservation, control and use of the waters of the Missouri Basin, generating power, conservation of wildlife, flood control, and water for municipal, domestic and industrial uses. The plan as outlined by the Bureau of Reclamation for North Dakota includes the diversion of water from the Missouri River, below Ft. Peck in Montana, into the northwest corner of this state to irrigate approximately one million acres of land in the Missouri-Souris Project, and diversion of all return flows from projects in the Souris River below Velva, by canal, into the proposed Sheyenne reservoir, the restoration of Devils Lake and diversion into the James River canal, where water will be available to irrigate approximately 55,000 acres of land in the New Rockford unit.

The Bureau plan provides for the construction of a reservoir on the James River above Jamestown, where water will be stored and made available to irrigate 22,000 acres in the vicinity of Jamestown. The Oakes unit, comprising 31,000 acres of irrigable lands, will be served from water released from the James River reservoir. In the restoration of Devils Lake, water will return through Stump Lake to the Sheyenne River for municipal and other uses along the Sheyenne and Red Rivers. The Bureau's plan also includes the development and construction of the Heart River irrigation projects, with two reservoirs on the Heart River, one at Dickinson and the other located south of Glen Ullin, known as the Heart Butte dam. The latter is now under construction and it is anticipated that the work will be completed in 1949, providing the necessary



Test Tunnel Entrance, at Garrison Dam, N. D.

funds are appropriated by the Congress. Sufficient storage water will be provided to irrigate nearly 15,000 acres from these two reservoirs.

There are two dams proposed for construction on the Cannonball River, one on the south branch known as the Thunderhawk dam and the other on the north fork located south of Elgin, known as the Elgin dam. Plans and specifications are being prepared and the Elgin dam is scheduled for early construction in 1949. These two reservoirs will supply water for the irrigation of approximately 17,000 acres of land.

Projects planned for irrigation development by the Bureau of Reclamation include the construction of projects on the Knife River. Construction of the Broncho Dam and irrigation works in the vicinity of Beulah and Hazen will irrigate 15,400 acres.

WILLISTON PUMPING IRRIGATION UNIT

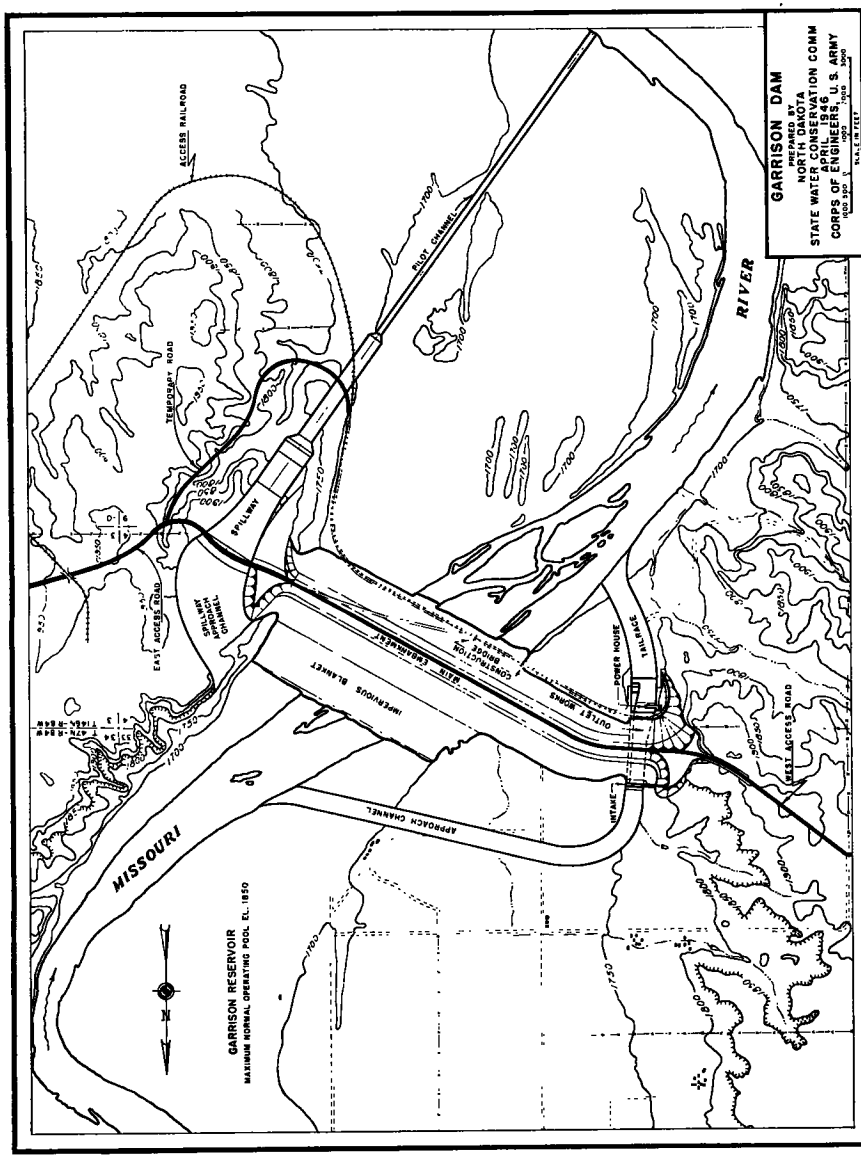
Included in the plans of the Bureau of Reclamation is the construction of a pumping irrigation project of approximately 7,000 acres in the valley of Little Muddy Creek and on the benchlands to the west, practically surrounding the city of Williston, in Williams County, North Dakota.

THE NESSON VALLEY PROJECT

Located about 26 miles east of Williston, in Williams and south of Ray in Mountrail counties, is what is called the Nesson Valley Pumping Project, of about 9,600 acres. This has been surveyed and lands classified, and is included in the construction plans of the Bureau of Reclamation for the development of the Missouri river diversion areas.

Several small irrigation projects have been surveyed and designed for irrigation by pumping from the Missouri River, located on the Missouri River below Garrison reservoir and south to the state line along the headwaters of the Oahe reservoir. These projects include: Mannhaven, Hancock Flats, Ft. Clark, Oliver-Sanger, Painted Woods, Manley, Wogansport, Square Butte, Burnt Creek, Little Heart, Horsehead Flats, Winona and Bismarck projects. They range in size from 2,000 to 9,000 acres.

Other surveys and studies being conducted by the Bureau include diversion from Garrison reservoir, now under construction by the Corps of Engineers. These plans include the irrigation of land in the vicinity of Underwood, Coleharbor and Washburn, and diversion over the divide into the upper reaches of the Sheyenne and James River drainage basins. Studies and investigations have been nearly completed by the Bureau for the construction of a dam and reservoir on the Sheyenne River for diversion into Devils Lake, to restore the lake to its former levels, with surplus waters restoring Stump Lake and all overflows being returned to the Sheyenne River.



Plan of the Garrison Dam, Under Construction in North Dakota

The Bureau of Reclamation has commenced studies and investigations for diversion of water from the Little Missouri into the headwaters of the Heart and Cannonball river basins for the irrigation of several large tracts of land in the vicinity of New England. Bruce Johnson, Bismarck, is acting district manager.

THE CORPS OF ENGINEERS

The Garrison Dam and Reservoir Project is being constructed by the Corps of Engineers, Department of the Army. In order to care for construction workers and engineering staff, the town of Riverdale is being built to house the personnel engaged in the design and construction of the dam. When completed, the town will house about 5,000 persons. It will be all modern and equipped with the latest facilities.

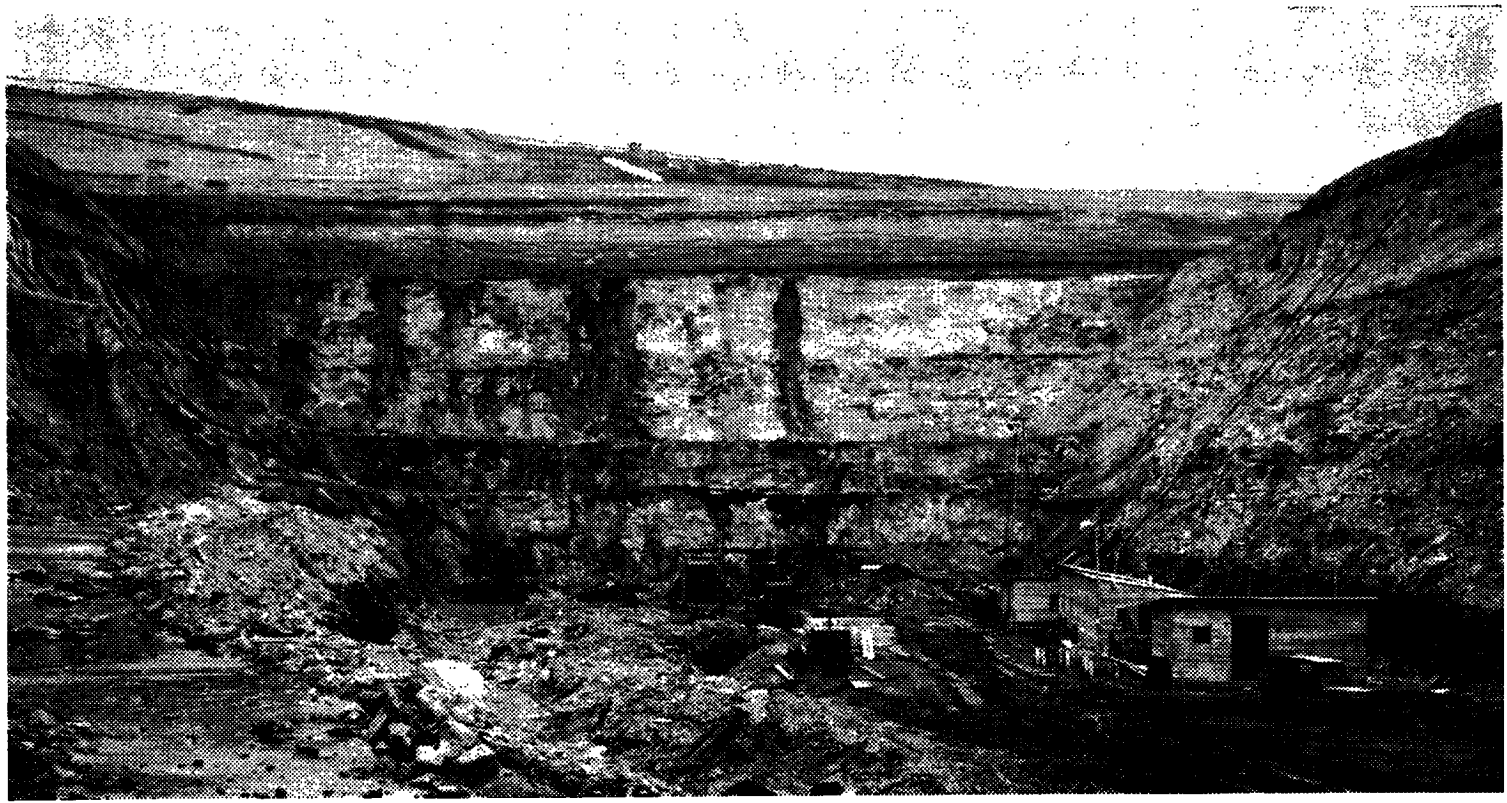
The dam and town are located on the Missouri River, approximately 77 river miles north of Bismarck, North Dakota. The Garrison Dam will be the largest rolled-fill earth embankment in the world. The dam will stretch across the Missouri River valley for more than two miles. It will rise more than 200 feet above the stream bed, contain about 70,000,000 cubic yards of carefully selected and segregated materials, will be faced with approximately 650,000 cubic yards of rock to protect against wave erosion, have 525,000 square feet of steel sheet piling driven 85 feet below the foundation earth to prevent under seepage, and carry on its crest relocated Highways 8 and 28.

The spillway in the east abutment will have its crest at elevation 1,825 feet above mean sea level and there will be 29 Tainter crest gates, 29 feet by 40 feet, along the 1,440 foot concrete spillway. The spillway weir, chute, and stilling basin will require about 840,000 cubic yards of concrete and 14,000 tons of reinforcing steel.

Eight tunnels will be driven through the west abutment for the release of water in the operation of the reservoir. The five power tunnels will have an inside diameter to the concrete lining of 29 feet, while for flood control and other purposes there will be two 22-foot and one 26-foot tunnels.

Below the downstream portal of the five power tunnels, a powerhouse will be constructed. Two generators, initially installed in the powerhouse, will have a capacity of 160,000 KW per year. Ultimately, it is planned that three more units will be added, making a total of 400,000 KW available.

It has been calculated that at maximum normal operating pool the reservoir will contain 23,000,000 acre feet of water (7,494,573,000,000 gallons). When full, the reservoir will be a huge man-made lake 200 miles long, better than 14 miles across at some points, and over 200 feet deep along the former river channel upstream from the dam. The shore line, approximately 1,500 miles long, will surround a surface area of 390,000 acres.



Garrison Dam "Big Hole" Tunnel Opening

The Garrison Reservoir will impound the flood waters for producing electric power, for improvement of navigation, for irrigation, sanitation and stabilization of municipal water supplies and will, in addition, provide facilities for recreation and for wildlife preservation.

This project is under the immediate supervision of Col. J. S. Seybold, District Engineer, Fort Lincoln, North Dakota. In addition to the construction of the Garrison Dam, all other flood control projects on the main stem of the Missouri river and its tributaries in North Dakota come under the direction of the District Engineer. These projects include levee repairs on the Lewis and Clark irrigation project, levee and bank protection on the Knife River for the towns of Beulah and Hazen and flood control work on the Heart River in the vicinity of Mandan. Funds have been appropriated by Congress for these works and construction will start just as soon as local contributions have been assured.

Further studies are being made covering the Cannonball River at Mott and the Grand River on the proposed Bowman-Haley irrigation project for flood control works. It is anticipated that the reports of the Corps of Engineers will be released soon.

Other investigations by the District office include surveys and studies of damages by erosion of river banks, shifting of the river bed, channel improvements, and the more recent petition from the land owners living on the proposed Square Butte irrigation project, where the Missouri river is rapidly destroying a large area of alfalfa land.

HISTORY OF IRRIGATION

Irrigation dates back to Biblical days:

> "And he said, Thus saith the Lord, Make the valley full of ditches.
>
> "For thus saith the Lord, ye shall not see wind,
>
> Neither shall ye see rain, yet that valley shall be filled with water, that ye may drink, both ye and your cattle, and your beasts."—II Kings, 3:16-17.

Irrigation had been established when the writings of history began. The British Society of Anthropology accepts as a fundamental doctrine, that historically civilization followed the invention of irrigation.

There are records of continuous irrigation for thousands of years in the valley of the Nile in Egypt, and comparatively long periods in Syria, Persia, India, China and some parts of Italy.

Modern irrigation in the United States dates from 1847, when the Mormons settled on the desert land in the Salt Lake valley of Utah. Previously, the prehistoric Indians of the Southwest practiced irrigation, and in New Mexico and in Arizona can be seen traces of ditches and irrigation canals built to convey water to the fields.

Big Dirt Mover Taking a Dive for Another Load, at the Garrison Dam, N. D.

The value of irrigation was very graphically described by Major J. W. Powell before the North Dakota constitutional convention in 1889. Referring to agriculture in this region, he said:

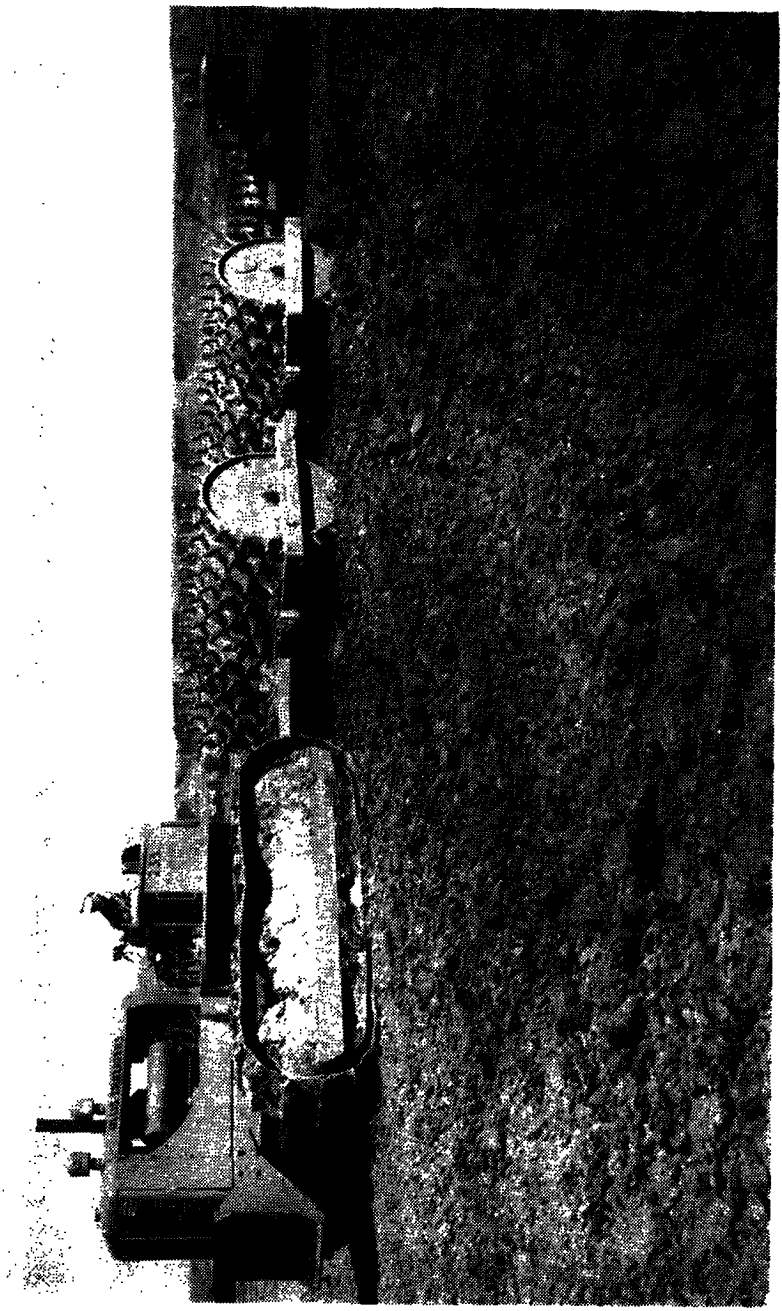
> "Years will come of abundance and years will come of disaster, and between the two the people will be prosperous and unprosperous, and the thing to do is to look the question squarely in the face and provide for this and for all years."
>
> "In the western portion all dependence on rain will ultimately bring disaster to the people. They are unwilling yet, a good many of them, to admit it, but * * * they will have to depend forever on artificial irrigation for all agriculture."
>
> "The State of North Dakota has a curious position geographically in relation to agriculture. The eastern portion of the state has sufficient rainfall for agricultural purposes; the western part has insufficient rainfall, and the western portion is practically wholly dependent on irrigation."

The U. S. Reclamation Act of 1902 states: "The right to the use of water shall be perpetually appertinent to the land irrigated, and beneficial use shall be made the basis, the measure and limit of the right." The irrigation development has been under the direction of the Bureau of Reclamation since 1902. To it Congress has authorized the construction of works to irrigate approximately 5,000,000 acres in the Missouri river basin into irrigated areas, one of the greatest water projects in the history of nations. In 1944, Congress gave preference to the uses of water for irrigation, municipal water and other uses west of the 98th meridian.

The early use of water for irrigation in the United States was largely in the desert areas where without water nothing could be grown, here ranchers diverted waters for the irrigation of their crops.

North Dakota, because of its strategic location near the headwaters of the Missouri basin, is to have one of the largest irrigated areas of any of the states in the basin. This will be scattered over the central and western portions of the state where average precipitation is low, and where drought has at times forced the loss of valuable herds of cattle and flocks of sheep, leaving the average farmer without income to sustain his family.

Forty years of experience on the Yellowstone Irrigation District, about 20,000 acres of which is in McKenzie County, North Dakota, gives a reliable index as to what can be expected of irrigated lands in North Dakota. In 1947 the average returns per acre on this irrigated tract



At the Garrison Dam the Earth Fill Is Packed Almost as Hard as Cement

was $80.17, with some returns from sugar beet fields averaging as high as $124 per acre.

By the use of conservation soil practices and with alfalfa in a rotation of crops the productivity of the soil is being gradually improved. In severe drought years like 1935, the average returns per acre with lower prices was $35, while returns from the surrounding dryland farming averaged only 70c per acre.

WATER COMMISSION

Cooperative Surveys

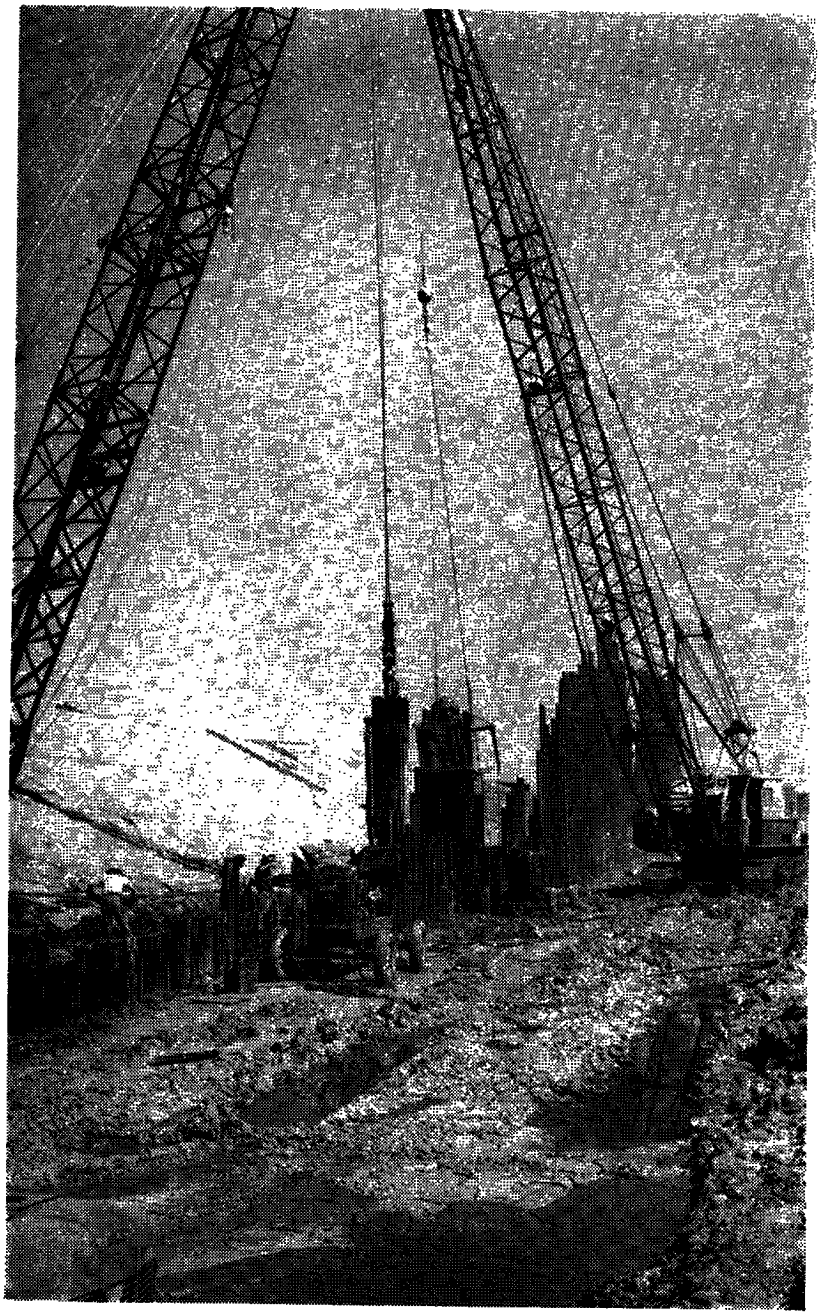
During the biennium, the State Water Conservation Commission has been engaged in making engineering surveys and investigations in cooperation with the Bureau of Reclamation, covering detailed surveys on the Cannonball and Cedar rivers, the Missouri,Souris project, Underwood, Washburn area, and miscellaneous surveys along the Missouri River, as well as reconnaissance surveys on the Knife, Heart, Cannonball, Mouse, Grand, Little Missouri and Missouri rivers. All detailed topographic surveys made by the Commission are being turned over to the Bureau of Reclamation for irrigation development studies as soon as completed.

Maintenance of Dams

During the last session of the State Legislature, $45,000 in funds were appropriated for the maintenance of existing dams. This work is being carried on under the supervision of the engineering department of the Commission, using state owned equipment. During the period, many requests were received for assistance in construction and reconstruction of spillways which have failed during the past years, since these structures were built by the Federal Government during the late 1930's. Such requests continue to increase. It is the policy of the Commission to require local aid and contributions in sharing in the cost of the repairs. Local contributions usually come from the county, city, or from local civic groups, and the State Game and Fish Department.

New Spillways Constructed

During the past year, we have had requests for the construction of several new spillways. Costs for repairing and reconstructing this type of structure varies from $5,000 to $15,000. Three of these larger type structures were built during the past two years, one located near Tolna, others near Watford City and Regent. We have applications for the reconstruction of a number of other large spillways that have failed during the heavy runoff of the last few years. The Commission has had the usual trouble in securing experienced technical help, skilled and common laborers.



Driving Steel Piling Cut-off at Garrison Dam

RECONSTRUCTION

Drainage or Irrigation

Another item in our appropriation is the reconstruction of drains or irrigation. The Legislature appropriated $200,000 to continue this work, which is largely located in the Red River of the North drainage basin, and consists of construction and reconstruction of drains for carrying off excess waters resulting from storms and floods. The work is being done on a cooperative basis, the State Water Conservation Commission furnishing 40% of the cost and the county or drainage district providing the other 60%. The Soil Conservation Service has agreed to supply the engineering and technical services required, without cost, to the drainage districts. There are considerable funds appropriated for this purpose that have not been used pending settlement of inter-county problems. However, it is anticipated that they will be used, or under obligation before the end of June, 1949.

Cooperative Surveys-Investigations

Three other items in the state appropriation for cooperative surveys and investigations include topographic surveys, mapping division; hydrographic surveys, surface water section; and underground water surveys. Groundwater surveys are being conducted in cooperation with the Department of the Interior, U. S. Geological Survey. Funds for conducting this work are being matched on a fifty-fifty basis, and the field studies are under the direct supervision of the various branches of the Geological Survey.

GROUND WATER STUDIES

More than sixty different municipalities have requested aid from the Water Commission to locate a sufficient supply of water for their community needs, and have contributed a portion of the cost of this very important work. The State Geologist, Dr. Wilson M. Laird, is cooperating with the U. S. Geological Survey, representing the State Water Conservation Commission, and is in actual charge of investigations, surveys and drilling operations, the truck, and other equipment which has been purchased by the Water Commission. The results have been quite successful in most communities which have been reached, and the work is progressing as fast as possible. The Geological Survey is making a report of each community explored and accumulating records which will be available for future reference.

FLOOD CONTROL

Flood control is another important phase of the water development plans for this state. This is a serious problem in the Red River valley during the periods of excessive precipitation and has resulted in large areas of crop land being flooded and damaged. The Corps of Engineers

On the Edge of the "Big Hole" from which Tunnels Are Being Driven

are cooperating with the State Water Commission in doing everything possible to solve this problem. Also, the U. S. Soil Conservation Service for the past three years has cooperated with the State Water Conservation Commission in the cleanout and construction of drainage ditches in the Red River valley.

INTER-AGENCY COMMITTEE

A Missouri Basin Inter-Agency Committee was organized in 1945, composed of a representative of the Corps of Army Engineers, the Bureau of Reclamation, the Department of Agriculture, the Federal Power Commission and the Department of Commerce. Also on this committee are five governors elected by the ten Governors of the Missouri basin states. Governor Fred G. Aandahl is a member of this committee, which meets monthly and through its efforts has coordinated the work of all groups, both federal and state, in a united program for the development of the waters of the Missouri basin.

The Missouri Basin Inter-Agency Committee has submitted for consideration by Congress in making appropriations a suggested six-year program of construction for the whole Missouri basin. This program provides for construction work in North Dakota totaling $640,624,651 of which $477,604,250 would be completed in the six-year program and $261,010,746 afterwards. Under this plan the deferred work would be largely on the Missouri-Souris and completion of the Buford-Trenton projects.

TOPOGRAPHIC SURVEYS

Topographic surveys are being continued by the U. S. Geological Survey crews in cooperation with the State Water Conservation Commission along the area on which construction is contemplated for the Missouri-Souris project and the diversion of water from Garrison reservoir.

STREAM FLOW MEASUREMENT

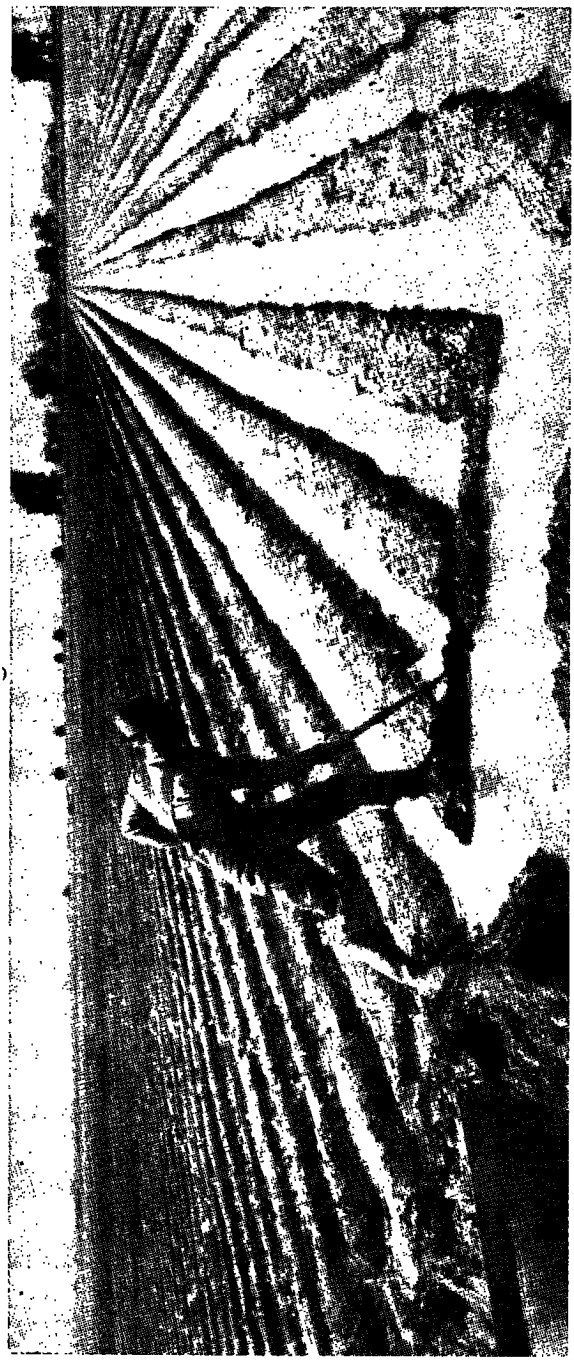
Stream flow measurements, so essential in planning dams and reservoirs, are being continued by the U. S. Geological Survey in cooperation with the State Water Conservation Commission.

REPAIR OF DAMS

The repair and reconstruction of several hundred small dams and spillways constructed by various federal agencies during the drought is becoming a serious problem to the state, counties and communities. It is the policy of the State Water Conservation Commission to share in the cost of these repairs with those being directly benefited, and the State Game and Fish Department is cooperating and sharing in these costs, where there are benefits to the propagation of fish and wildlife.

POTENTIAL IRRIGATION IN NORTH DAKOTA

With irrigation of a potential million acres in the Missouri-Souris project, possibly 500,000 acres in central North Dakota from the Gar-



Irrigation will Play Vital Role in the Nation's Future Economy

rison reservoir, 70,000 or more acres in the Missouri river pumping projects, 15,000 in the Heart river and Dickinson projects, and possibly about the same acreages on the Cannonball and Knife rivers, it seems safe to predict that the total irrigated acreage in North Dakota will aggregate ultimately more than 1,500,000 acres.

IRRIGATED LAND AREAS IN THE U. S.

A map of the United States shows by graphs the irrigated and non-irrigated lands in each state. California leads with the largest irrigated acreage. Montana has about 1,700,000 acres under irrigation. North Dakota is next to the bottom of the list, but with the completion of the Missouri river water development plans it will have one of the largest irrigated areas. The total land irrigated in the United States is over 21,000,000 acres, involving an investment of $1,052,049,201, averaging $34.36 per acre.

Lewis & Clark Irrigation District

This project comprises 5,000 acres of irrigated land, located near Williston, North Dakota, and was developed by the North Dakota State Water Conservation Commission with financial aid from the Rural Rehabilitation Corporation. This project has been in successful operation since its completion in 1941. The land was cropped as soon as water was available. It was first farmed under leases but in 1945 sold to the individual operators. There were more applicants to purchase this irrigated land from dry-land farmers in the area than could be supplied.

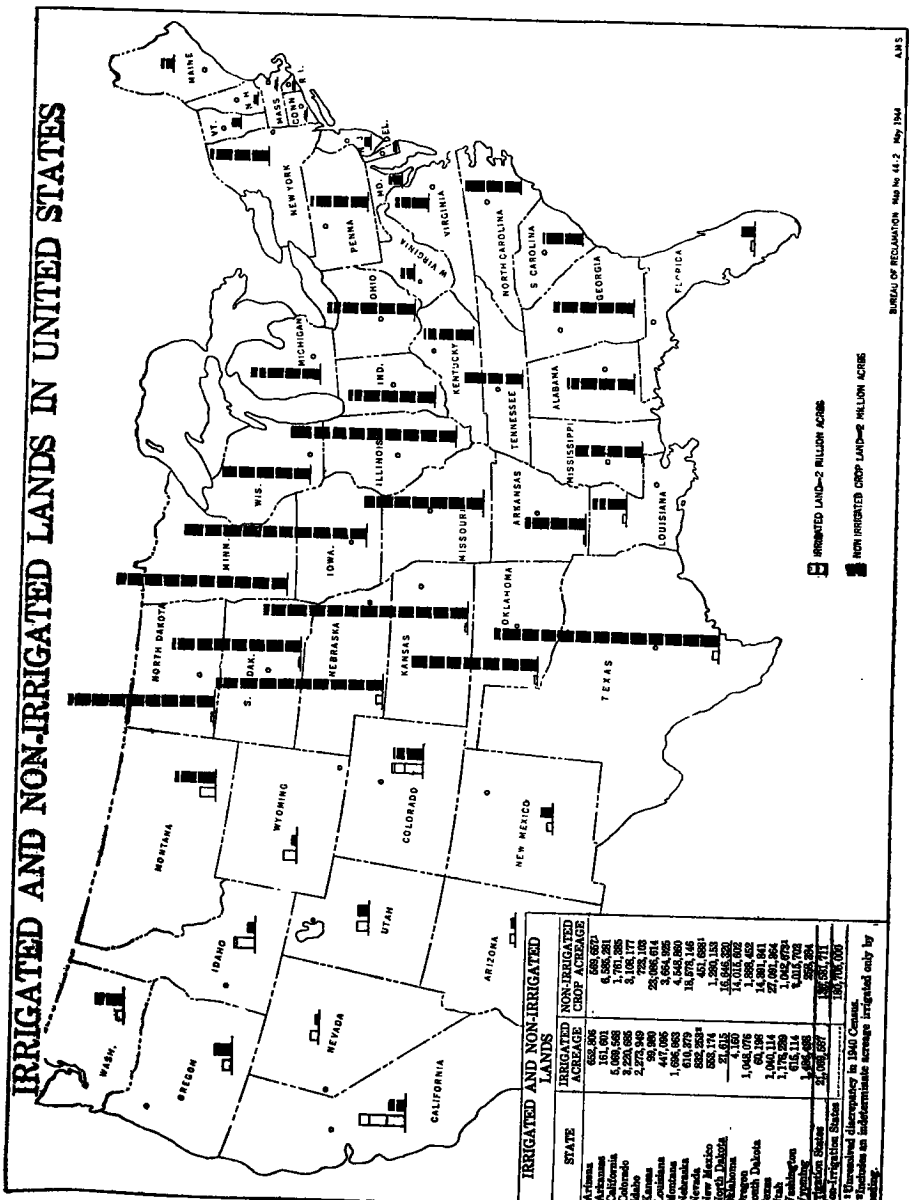
Fifty-two former dry-land farmers have purchased these irrigated farms, averaging 115 acres each. Before irrigation, the average gross income from the tract was $7,900. The 1945 gross income under irrigation was $158,085 as shown by the project report, with steadily increasing income since that time.

Buford-Trenton Irrigation District

This tract consists of 14,400 irrigable acres of Missouri river bottom land in Williams County, North Dakota, a few miles west of Williston. More than 8,000 acres has been prepared for irrigation. This land has been divided into 80 farm units averaging from 110 to 130 acres each, which experience has proved to be about ideal under irrigation.

Before irrigation, this tract of land produced a gross return of $47,800. In 1945, with 5,200 acres irrigated and 3,370 acres still dry farmed, it produced a gross return of $220,157, according to the records of the project supervisor. The gross returns in 1947 were $397,517.50, or $51.71 per acre.

The average price for irrigated land on this project with small sets of buildings is $100 per acre. There has been more demand for these irrigated farms from dry-land farmers of that area than could be supplied.



IRRIGATED AND NON-IRRIGATED LANDS

STATE	IRRIGATED ACREAGE	NON-IRRIGATED CROP ACREAGE
Arizona	662,806	589,657
Arkansas	1,151,671	6,595,261
California	5,098,561	3,776,795
Colorado	2,220,695	3,108,177
Idaho	2,273,949	722,103
Kansas	99,880	22,095,614
Louisiana	447,095	3,654,095
Montana	1,896,993	4,548,860
Nebraska	1,601,270	18,478,146
Nevada	882,253[1]	1,451,781
New Mexico	858,174	1,290,138
North Dakota	21,615	16,645,320
Oklahoma	4,150	14,015,002
Oregon	1,040,076	1,888,452
South Dakota	60,198	14,801,041
Texas	1,067,114	27,002,264
Utah	1,176,220	1,487,670
Washington	615,114	9,015,702
Wyoming	1,464,485	898,254
Irrigation States	20,000,267	136,561,711
Non-Irrigation States	.....	194,705,005

[1] Unreconciled discrepancy in 1940 Census.
[2] Includes an indeterminable acreage irrigated only by seepage.

The project was reconstructed by the Bureau of Reclamation in cooperation with the Department of Agriculture, and is being enlarged as fast as Congress provides funds.

NORTH DAKOTA IRRIGATION DEVELOPMENT

The graph showing North Dakota Progress of Irrigation Development from 1889 pictures to the eye the gradual growth. Progress has been steady, except for some years of heavy rainfall. The increase of irrigation has been very rapid since the organization of the State Water Conservation Commission in 1937. During this period, irrigation has increased from about 17,000 acres to over 40,000 acres. The Missouri river development plan now under construction will increase the irrigated acreage to one and a half million acres, or more.

HEART RIVER UNIT—NORTH DAKOTA

Irrigation of 12,893 acres of land, with flood control, silt retention and water for municipal use, will be provided by the Heart river reservoir, west of Mandan.

Construction began in the spring of 1948 on the Heart Butte dam, located up the river about sixty miles from Mandan. It is hoped to complete this structure by the end of 1949. The reservoir, when filled to capacity, will back up water about 21 miles, with storage capacity for 300,000 acre-feet;—225,000 acre-feet storage is for flood control and 25,000 acre-feet for silt retention, the balance for irrigation. All irrigation water will be pumped from the river, which will be provided by releases from the Heart Butte reservoir.

Bids for Dickinson Dam

It is planned to start construction work on the Dickinson dam on the Heart river early in the spring of 1949. The reservoir will provide water for the city of Dickinson and for irrigating about 1,000 acres by pumping from the reservoir and from the river below the dam. Five bids have been received and construction contract awarded.

Bureau of Reclamation engineers have charge of the construction of the Heart river projects.

HYDROELECTRIC POWER

The Garrison dam hydro-electric generating plant is designed to develop 400,000 kilowatts, or about three times the total amount of electric power now generated in North Dakota. This abundance of low cost power should eventually mean the electrification of most farms in the state.

It will utilize a water resource that is now being wasted, and will conserve a corresponding portion of the coal resources of the nation. It is predicted that this abundance of low cost power should bring new

Heart Butte Dam Under Construction on Heart River, November, 1948

industries to the state. Inquiries received by the Water Commission indicate that plans are already under way for the installation of plants needed to process and market the additional farm products which will be produced under irrigation.

SOIL PRODUCTIVITY

The experience of recent years in North Dakota, with more than the normal rainfall, has proved conclusively the wonderful productivity of the soils of North Dakota. Under irrigation, with water applied as needed, the productivity can be doubled and in some cases trebled as compared to dry land farming. The Yellowstone irrigation district, with more than 20,000 acres in McKenzie county, North Dakota, produced in 1947 an average of $80.17 per acre, with some returns as high as $124 per acre. This is probably the best index as to what can be expected and demonstrates the value of irrigation. With the use of soil conservation methods, rotation of crops to build up the productivity of the soil, and with needed water by irrigation, the yearly returns should bring added prosperity to the state.

PROGRESS ON OTHER IRRIGATION UNITS

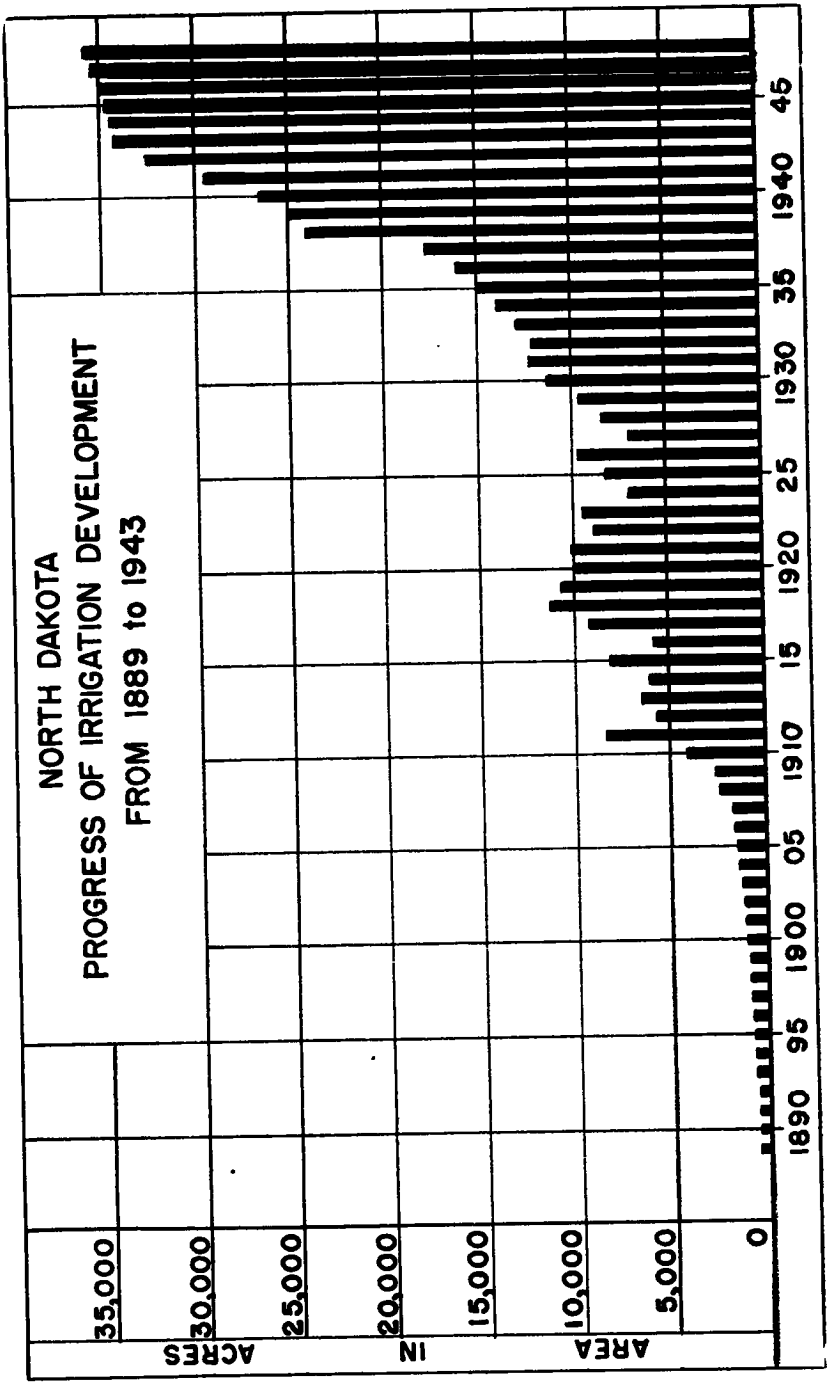
Missouri-Souris Units

Congress appropriated $285,000 for construction of a Missouri-Souris diversion dam to be located in the Missouri river a few miles below Fort Peck dam in Montana, and another appropriation of $700,000 for construction and detailed surveys for location of canals and other structures required to bring water across the northeastern corner of Montana to the Missouri-Souris irrigation project in northwestern North Dakota. Offices have been established by the Reclamation Bureau at Wolf Point, Montana, and Minot, North Dakota, with district headquarters in Bismarck, North Dakota.

Missouri River Pumping Projects

These include a number of irrigation units along both sides of the Missouri river from the Garrison dam south to the state line. The Fort Clark unit has been organized as an irrigation district. Detailed surveys are completed for the irrigation of 1,882 acres. It is planned to complete construction work and pump installation in 1949, if possible. This will probably be the first of the irrigation pumping units to be constructed on the Missouri river, south of Garrison dam.

More than 47,000 acres may be irrigated by these projects, which include the Underwood area; Hancock Flats, Oliver-Sanger unit, west of Washburn; Painted Woods unit, south of Washburn; Wogansport unit, north of Bismarck; Square Butte unit, north of Mandan; Manley unit, northwest of Bismarck; Burnt Creek, northwest of Bismarck; Bismarck unit, south of the city; Little Heart unit, southeast of Mandan; Horsehead Flats unit, on Beaver Creek, west of Linton; Winona unit, northeast of Winona; and the Fort Yates unit, south of Fort Yates.


NORTH DAKOTA
PROGRESS OF IRRIGATION DEVELOPMENT
FROM 1889 to 1943
AREA IN ACRES
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1890
95
1900
05
1910
15
1920
25
1930
35
1940
45

State Water Commission engineers and crews have been making topographic surveys in the Underwood area this summer, preparatory to irrigation when water is available from the Garrison reservoir. Necessary surveys and plans and specifications for the other pumping units will be completed as fast as possible.

Central North Dakota Served

Bureau of Reclamation engineers are exploring the possibilities of diverting water from the Missouri-Souris project into the Sheyenne and James river basins, by constructing a dam near the town of Velva to supply the proposed Sheyenne reservoir. Water from this reservoir will be used to restore Devils Lake and Stump Lake. All return flows will be diverted to the Sheyenne river and stored by the Baldhill reservoir for use in the Red River valley. This plan provides for a reservoir in the Sheyenne river with provision for diversion of the waters as needed, either into Devils Lake, down the river, and with a diversion canal which will permit surplus waters to be run into the James river to be caught by the Jamestown dam and reservoir.

Garrison Reservoir Diversion

Plans of the Corps of Engineers provide for a pumping station from the Garrison reservoir near Mercer to raise the water 50 feet over the divide near McClusky. From the high point, the water will flow north into the valley south of Minot for irrigation purposes, and flow east into the Fessenden, New Rockford and Carrington areas to irrigate approximately 880,000 acres. This will also permit the development of electric power and the channeling of water into Devils Lake.

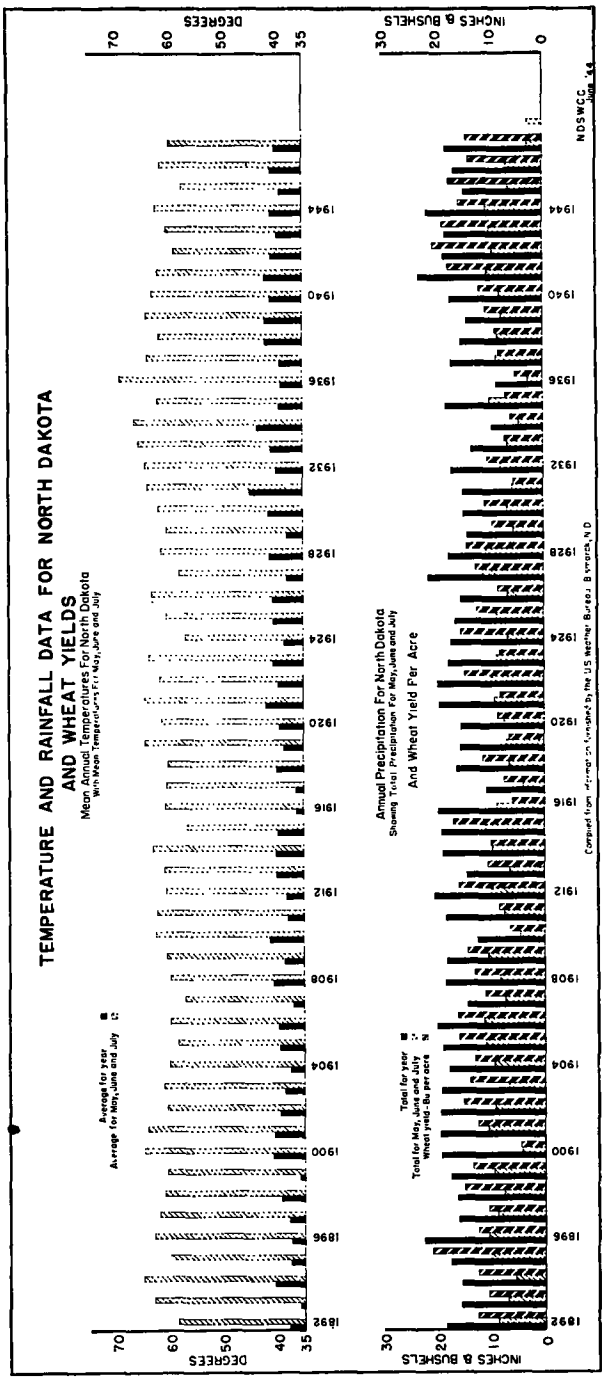
Yellowstone Pumping Irrigation District

This project in western McKenzie County, North Dakota, was originally planned as an extension of the Sidney pumping project in Montana, which derives its water from the Yellowstone river. North Dakota Water Commission engineers made detailed surveys and estimates. Due to the war, increased costs and shortage of needed materials, construction work was stopped before it reached the North Dakota state line. Plans are now under way to develop this project under the supervision of Bureau of Reclamation engineers as soon as it can be reached on their program for construction.

Devils Lake

Restoration of the waters of Devils Lake to an elevation of 1,420 feet above sea level is a part of the plans now under consideration by the Corps of Engineers and the Bureau of Reclamation by diversion of waters of the Missouri river.

Recent reports of engineers of the Bureau are that by speeding up the construction of canals and necessary diversion works, it is hoped to get water to Devils Lake several years earlier than first anticipated.


TEMPERATURE AND RAINFALL DATA FOR NORTH DAKOTA
AND WHEAT YIELDS
Mean Annual Temperatures For North Dakota
With Mean Temperatures For May, June and July
Average for year
Average for May, June and July
DEGREES
70
60
50
40
35
1892
1896
1900
1904
1908
1912
1916
1920
1924
1928
1932
1936
1940
1944
Annual Precipitation For North Dakota
Showing Total Precipitation For May, June and July
And Wheat Yield Per Acre
Total for year
Total for May, June and July
Wheat yield-Bu per acre
INCHES & BUSHELS
30
20
10
0
NDSWCC
Mar '44
Compiled from data furnished by the U.S. Weather Bureau, Bismarck, N.D.

The water surface of Devils Lake has receded since the earliest year of record, 1867. At that time the lake covered an area of 142 square miles and had an elevation of 1,438.9 feet above sea level. The map in this report shows the shore line in 1882, at which time the water area covered approximately 120 square miles and the elevation of the water surface was 1,434. The shore line in 1928 covered an area of about 35 square miles and showed an elevation of 1,413.4 feet. The lowest elevation recorded reached 1,400.9 feet in 1941, with an area of about 4½ square miles. During recent heavy precipitation years the lake waters have risen to 1,404 feet, where the level has been almost stationary.

Average Wheat Yields

A North Dakota Agricultural College bulletin, showing average wheat yields for the past 35 years in North Dakota, by Dean H. L. Walster, Chief of the Extension Service, gives much valuable information. Included in this report is a graph showing by counties, the years on which wheat yields were 15 bushels to the acre, or more. There is also a reproduction of a map of North Dakota with the average wheat yields given for each county for the 35 years. Both reports indicate the need of more moisture in North Dakota.

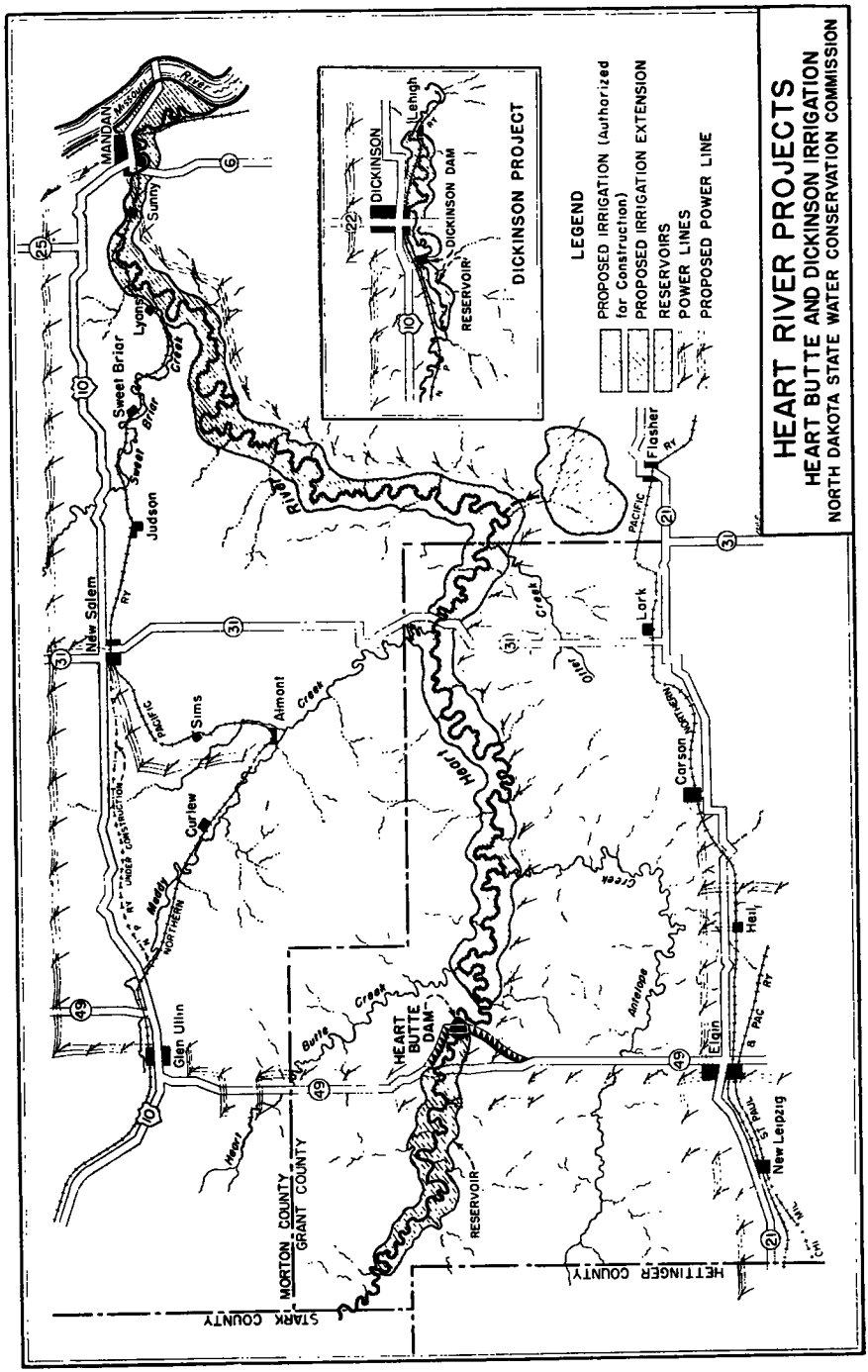
Wheat Yields Under Irrigation

A report of average wheat yields per acre under irrigation, prepared by Axel Persson, Project Manager of the Lower Yellowstone Irrigation project, shows 20,000 acres in McKenzie County, North Dakota, with a 20 year average wheat yield of 23.31 bushels per acre. Broken down, it shows the wheat yield for eight drought years in the thirties to average 18.6 bushels to the acre, and during the twelve wet seasons the yield averaged 26.45 bushels to the acre. The highest average yield of wheat on the project was in 1942, 31.9 bushels to the acre, on a total of more than 6,000 acres. Average wheat yields, as well as on other grains, have been gradually increasing on this project.

LOWER YELLOWSTONE IRRIGATION PROJECT
(In North Dakota and Montana.)

About the best index as to what may reasonably be expected in returns from irrigated lands in North Dakota are the results obtained under irrigation on the Lower Yellowstone irrigation project, which has been in operation for 40 years. Twenty thousand acres are in McKenzie County, North Dakota, with 38,000 acres in Montana.

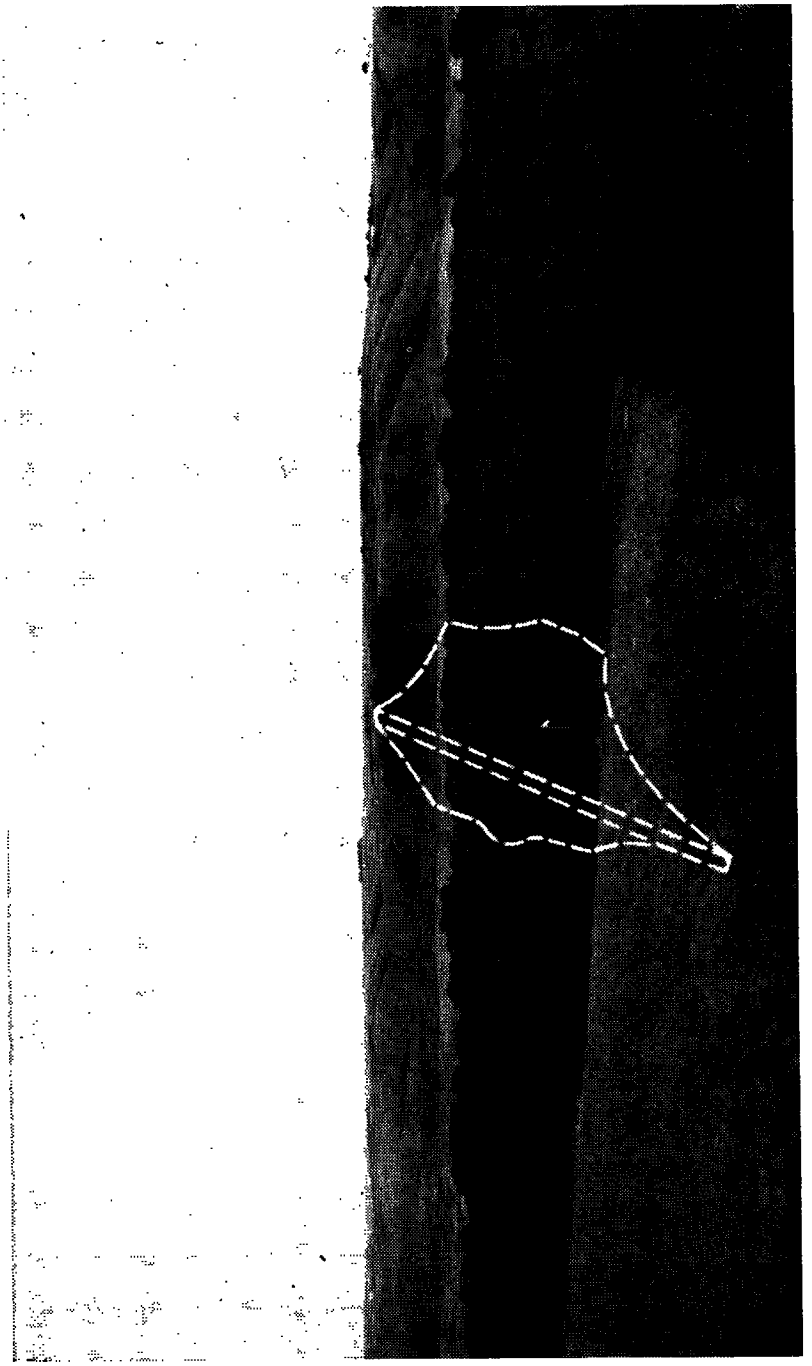
The report of the Project Manager shows an average return per acre of $80.19 during the 1947 season on irrigated lands. The sugar beet crop of 15,273 acres shows an average return of $126.34 per acre. For the five previous years, the average returns per acre were in excess of $65.


HEART RIVER PROJECTS
HEART BUTTE AND DICKINSON IRRIGATION
NORTH DAKOTA STATE WATER CONSERVATION COMMISSION
LEGEND
PROPOSED IRRIGATION (Authorized for Construction)
PROPOSED IRRIGATION EXTENSION
RESERVOIRS
POWER LINES
PROPOSED POWER LINE
DICKINSON PROJECT
DICKINSON
Lehigh
DICKINSON DAM
RESERVOIR
MANDAN
Missouri
River
Sunny
Lyons
Sweet Briar
Sweet Briar Creek
Judson
New Salem
Sims
Almont
Creek
Curlew
Glen Ullin
Heart
Butte
Creek
HEART BUTTE DAM
RESERVOIR
HEART RIVER
Oliver Creek
Flasher
Lark
Carson
Antelope Creek
Hail
Elgin
New Leipzig
Pacific
Northern
Chicago & N. W.
Chicago Milw. St. Paul & Pac. Ry.
MORTON COUNTY
GRANT COUNTY
STARK COUNTY
HETTINGER COUNTY

LOWER YELLOWSTONE IRRIGATION DISTRICTS 1 and 2
In North Dakota and Montana
45,026 Acres

Crop	1943 Av. Yield	1943 Acre Value	1943 Total	1944 Av. Yield	1944 Acre Value	1944 Total	1945 Av. Yield	1945 Acre Value	1945 Total	1947 Av. Yield	1947 Acre Value	1947 Total
CEREAL:												
Barley	40.5	$ 32.46		41.2	32.93		33.4	28.41		39.51	55.31	
Corn	32.1	32.12		34.9	34.91		19.4	19.44		35.17	52.76	
Oats	55.3	29.31		54.2	27.12		44.2	22.18		55.88	44.71	
Wheat	31.4	36.68		30.6	39.81		26.5	37.16		30.71	74.63	
Speltz	61.2	30.59		44.9	22.47		30.2	16.60		42.04	42.04	
Totals			$ 480,262.00			512,460.00			408,226.00			$1,080,936.51
SEED:												
Alfalfa	2.7	55.65		1.1	23.01		1.2	25.59		1.52	30.37	
Clover				3.1	13.14		3.2	19.29		4.00	24.00	
Flax	10.6	28.14		10.5	29.15		7.0	19.40		10.21	61.27	
Millet				15.0	11.25					17.42**	48.78**	
Soybeans				57.8	7.03							
Totals			29,245.00			9,433.00			14,003.00			74,733.60
FORAGE:												
Alfalfa	2.1	22.89		2.1	22.61		1.9	22.40		1.92	28.87	
Other Hay	1.3	7.83		1.2	7.17		3.6	6.41		1.00	5.98	
Corn Fodder	2.1	7.24		1.4	4.74		2.1	7.18		1.57	7.83	
Corn Silage	6.5	13.04		6.6	13.17		5.2	10.46		6.72	20.15	
Sugar beet tops	10.0	4.02			2.22			1.95			5.62	
Natural pasture		.50			.50			.50			.50	
Tame pasture		10.00			12.00			12.00			10.00	
Other pasture		2.00			2.00			2.00			2.00	
Totals			$ 303,962.00			$ 291,422.00			$ 259,809.00			$ 225,873.50
VEGETABLES:												
Beans, commerce	9.4	34.96		9.7	35.84		11.1	65.76		9.5	45.04	
Onions, dry	125.0	150.00										
Potatoes, white	72.2	72.20		120.0	120.02		*88.8	53.31		65.55	59.00	
Gardens, truck		72.50			58.36			71.88			83.27	
Totals			181,158.00			99,491.00			52,551.00			74,610.90
Sugar beets	10.0	82.53	977,350.00	11.1	111.28	1,558,883.00	9.6	90.15	1,482,465.00	11.25	126.34	1,482,465.00
Additional revenues			770,345.00			460,256.00			463,260.00			498,037.25
TOTAL VALUE CROPS			$2,742,322.00			2,931,996.00			2,680,320.00			$3,833,775.28
AV. VALUE PER ACRE			59.65			62.69			57.13			80.19

*(Hail damage reduced yields and returns for 1945 on part of project) (**Peas)



Site of Sheyenne River dam and reservoir, near New Rockford, North Dakota

LOWER YELLOWSTONE IRRIGATION DISTRICTS 1 and 2
In Montana and North Dakota
45,026 Acres
Livestock Inventories
1947

	November 31, 1946			November 31, 1947		
	Number	Value	Total value	Number	Value	Total value
Horses-Mules	569	$ 31.06	$ 17,673.00	388	$ 37.11	$ 14,400.00
Cows	1,817	76.82	139,576.00	1,584	100.85	159,751.00
Cattle, Feeders	4,541	86.76	393,969.00	4,415	114.85	507,055.00
Cattle, Dairy	1,254	94.99	119,115.00	1,746	116.61	203,605.00
Purebred Sires	83	205.42	17,050.00	57	272.28	15,520.00
Grade Sires	17	119.41	2,030.00	26	152.88	3,975.00
Sheep, Farm Flock	1,382	9.21	12,722.00	619	10.14	6,277.00
Sheep, Feeders	97,274	10.15	987,154.00	114,277	12.75	1,457,208.00
Hogs	2,448	29.22	71,529.00	2,376	36.00	85,540.00
Turkeys	1,067	5.84	6,228.00	812	6.60	5,411.00
Chickens	21,108	1.09	23,092.00	13,946	1.75	24,436.00
Other Fowl	.....	.....	645.00	.....	.....	1,258.00
Bees, hives	824	.....	18,901.00	921	.....	18,420.00
Totals	.....	.....	$1,137,413.00	.....	.....	$1,367,365.00

Homme Dam, near Park River, North Dakota, under construction

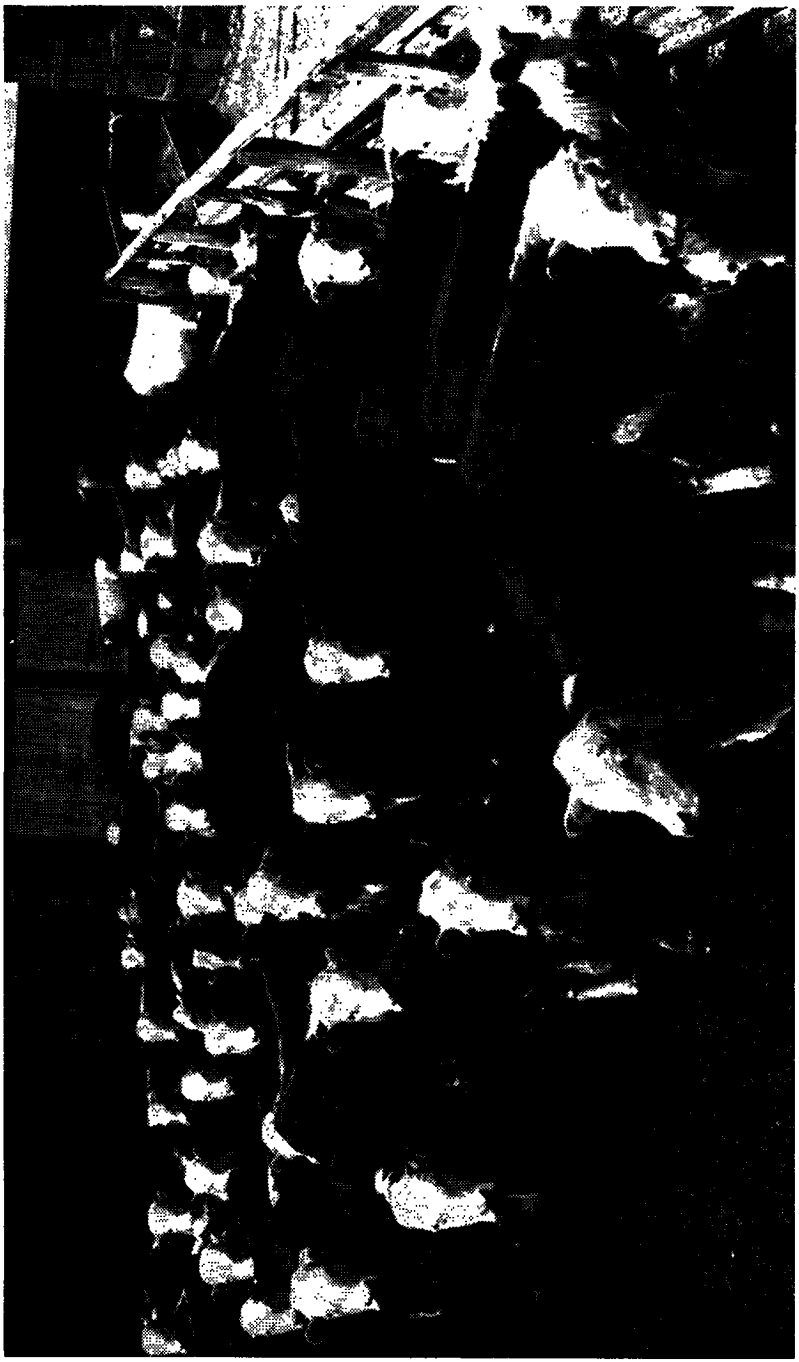
Raising Fruit Under Irrigation for a Balanced Diet

Millions of dollars are being paid out annually in North Dakota for the fruit juices needed to provide a healthy balanced diet. Nutritionists state that a minimum of at least two servings of fruit per day should be consumed by every individual in order to be healthy and save doctor bills. A survey made in western North Dakota shows that people both in towns and on the farms are consuming considerably less than this minimum requirement.

Visitors on the Lower Yellowstone Irrigation District have been amazed at the apples, crabapples, pears, cherries, plums, raspberries and strawberries being produced, indicating that with water this area can produce most of the fruit juices which should be included in a balanced diet. A few small irrigated acres in different communities are producing strawberries, raspberries and small fruits which for several years past have yielded more than a thousand dollars per acre.

All of which indicates that with the coming of irrigation that gardeners trained in the raising of hardy fruits can produce most of the fruit juices required for the residents of the state, thus saving millions of dollars which goes to other fruit-raising areas together with heavy transportation charges. Harry Graves, Extension Horticulturist, states, "You can grow fruit in North Dakota." George Will, who with his father have been nurserymen at Bismarck for more than sixty years, confirm this statement. Pioneer fruit raisers are showing remarkable samples of fruit raised, at the different fairs in the state.

Hebron Dam Spillway Washout



Hereford steers being fed for market on the Lower Yellowstone Irrigation project utilizing sugar beet pulp in a balanced ration

MISSOURI-SOURIS PROJECT

The Missouri-Souris project is designed to divert water into the Missouri Canal from the Missouri river below Fort Peck by means of the Missouri River Diversion Dam, and by a system of reservoirs and canals utilize that water for irrigation in eastern Montana and the northern portion of North Dakota.

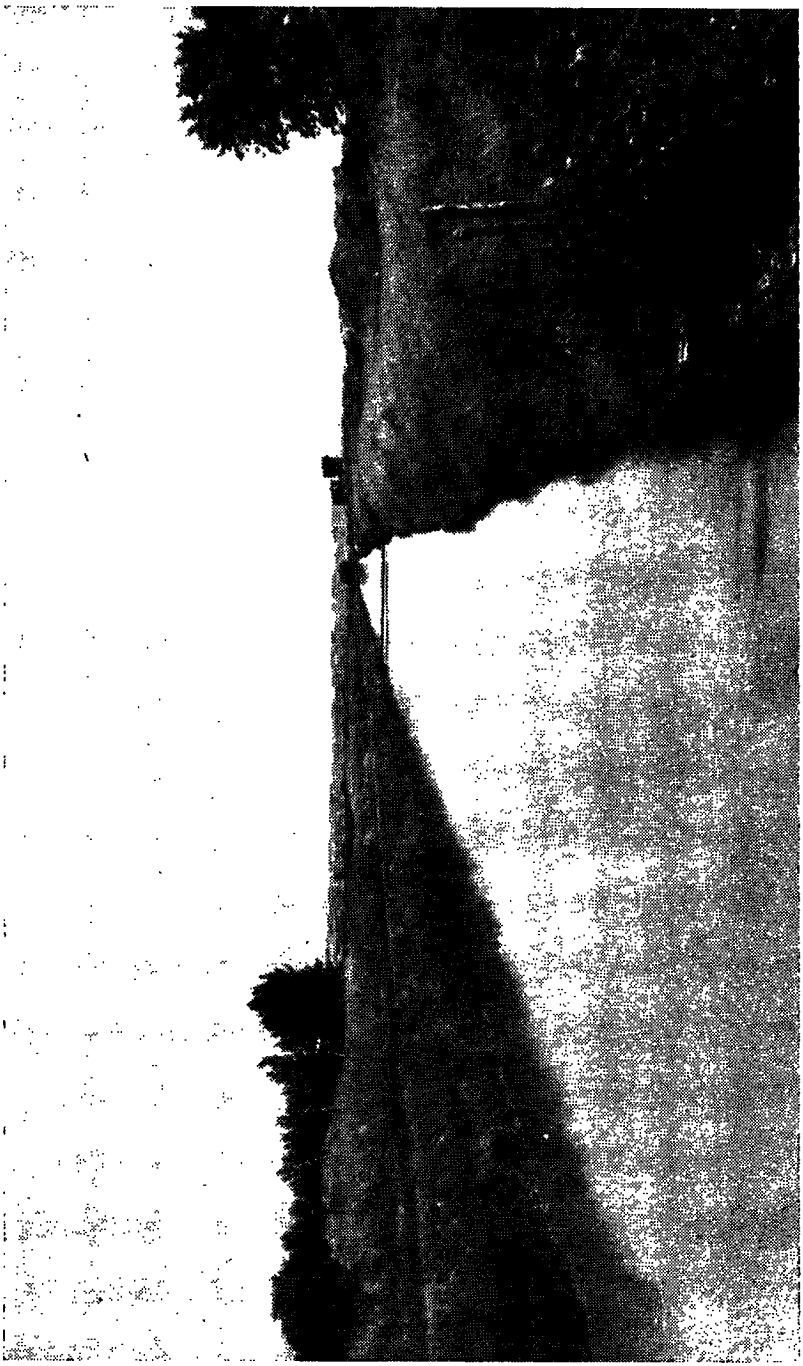
This project in Montana includes a total of 166,600 acres in ten separate units in the eastern part of the state, of which 121,000 acres will be served by the Missouri Canal diverting water from the Missouri river with several pumping lifts and relifts from the canal. The main, or Missouri Canal, with a capacity of 7,500 cfs. will also be used as a supply canal for Medicine Lake Reservoir, which will be formed by the construction of a dam on Big Muddy Creek and will have a gross capacity of 5,200,000 acre-feet or a live storage capacity of 1,700,000 acre-feet.

It will be used as a regulating reservoir for the Missouri-Souris project in North Dakota, and the storage provided will take up the heavy demand during the irrigation season and allow the use of a smaller Missouri Canal. The other 45,600 acres in Montana will be supplied by pumping and diversion from Medicine Lake Reservoir.

This project in North Dakota includes a total irrigable area of 1,108,500 acres, of which 1,000,000 acres is in the Crosby-Mohall area, 55,500 acres in the New Rockford area, 22,000 acres in the Jamestown area, and 31,000 acres in the Oakes area. These lands will be furnished water by the Grenora pumping plant with a lift of 90 to 103 feet from Medicine Lake Reservoir to the Souris canal.

The Souris canal, with an initial capacity of 12,000 second-feet will carry water to the Crosby-Mohall area. The water will drop through the Crosby and Des Lacs power plants, generating energy which will be utilized at the Grenora pumping plant. A by-pass from the Souris canal will deliver water into the Crosby Reservoir, which will store water for peak irrigation demands and assist in generating power at the Des Lacs power plant.

Return flows from the Crosby-Mohall area are to be diverted into the Sheyenne river. The Sheyenne dam will form a reservoir from which water is to be diverted to restore Devils Lake and supply water for municipal use in the Red River valley. The New Rockford area will be supplied by pumping from the south bank of the Sheyenne Reservoir. Water is also to be diverted from the right abutment of the Sheyenne dam into the James river valley to serve the Jamestown and Oakes areas. These flows will be regulated by the Jamestown reservoir formed by a dam on the James river located approximately two miles above Jamestown, North Dakota. Water will be diverted from the reservoir by canal and "pump lift" to irrigate the Jamestown sub unit. The dam will also be used for flood control.



Main Canal on Lower Yellowstone Irrigation District irrigating about 20,000 acres in North Dakota and 38,000 acres in Mont.

HEART RIVER PROJECT

North Dakota

Heart River Project, located in southwest North Dakota, involves construction of two reservoirs and a system of pumping plants and canals. Irrigation will be provided for approximately 14,000 acres. Flood control, silt control and municipal water supply will be additional benefits.

Heart Butte Reservoir of the Heart River Unit about 60 miles above the mouth of the Heart River at Bismarck and Mandan, will store water for irrigation of 13,100 acres of land. The dam will be an earthfill structure with a height of 124 feet above the stream bed and a crest length of 1,850 feet. It will have a total storage capacity of 428,000 acre-feet, of which 6,800 acre-feet is for dead silt storage, 63,200 acre-feet is for active irrigation storage and 358,000 acre-feet is for flood storage.

Irrigation of the lands below Heart Butte Dam will be accomplished by lifting water from the river channel into the separate tracts of land by means of 49 pumping plants, ranging in size from 3 to 50 cubic feet per second capacity. A system of canals and laterals will deliver water to the land to be irrigated. Several relift pumping stations are also included in the plan of development.

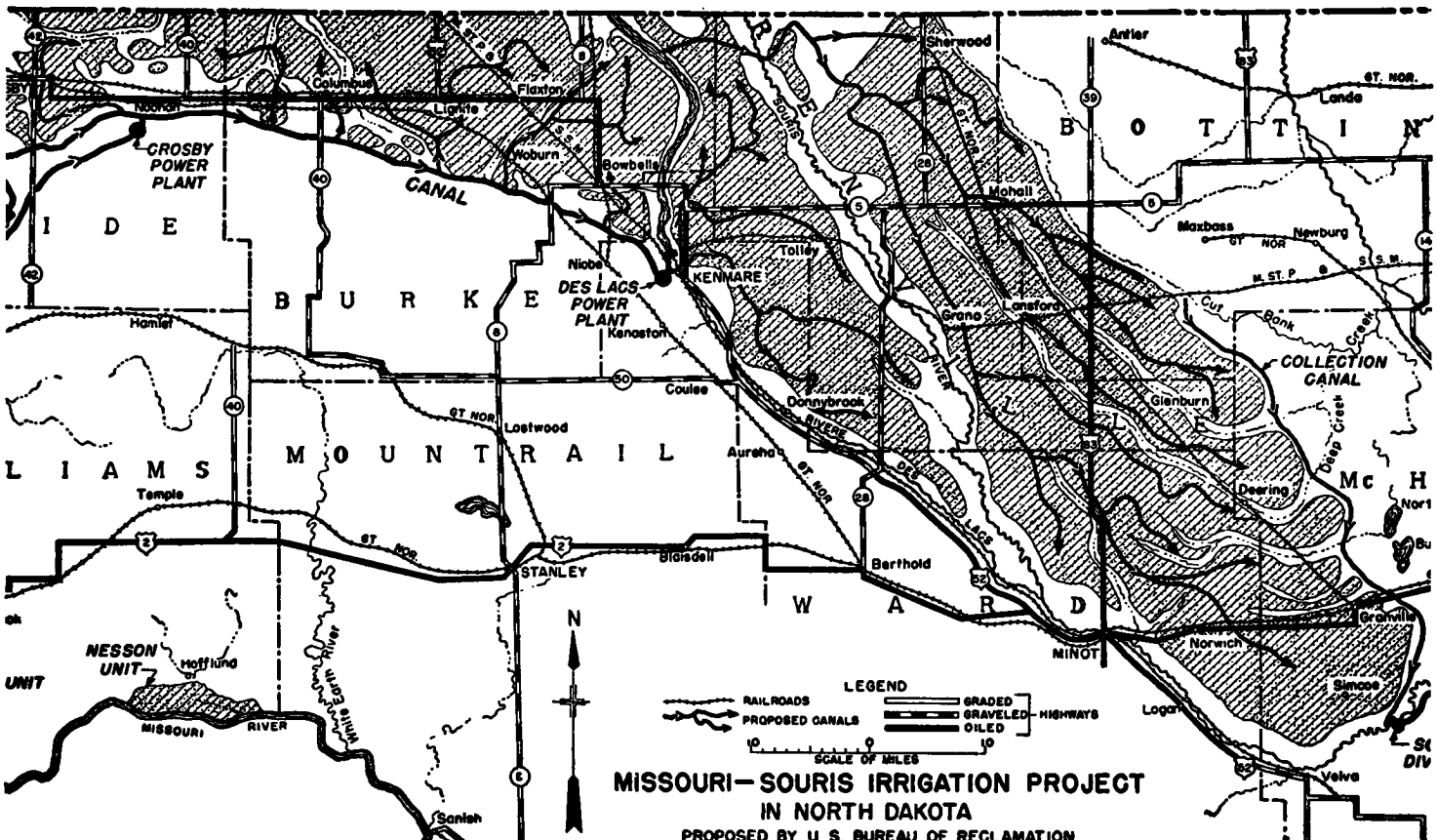
Dickinson Unit

Dickinson Reservoir, one and a half miles above the town of Dickinson, will be constructed to provide water for municipal use and for irrigation of 915 acres of land. It will have a total storage capacity of 16,500 acre-feet, including 3,000 acre-feet for silt storage, 4,000 acre-feet for active irrigation and municipal water storage, and 9,500 acre-feet for flood water storage. The dam will be of the earthfill type with a height of 45 feet above the river bed and a crest length of 1,600 feet. Land to be irrigated consists of small parcels which will be served by seven pumping plants.

CANNONBALL RIVER BASIN PROJECT

North Dakota

The Cannonball Project consists of Cannonball and Thunderhawk dams, with facilities for the irrigation of 17,750 acres of land. The Cannonball Reservoir site in southwestern North Dakota lies approximately 30 miles above the junction of the Cedar and Cannonball rivers. The reservoir will have a capacity of 193,000 acre-feet and provide 40,000 acre feet of storage for the irrigation of approximately 9,710 acres, with 5,000 acre-feet for silt retention and 148,000 acre-feet of flood control storage. The dam will be an earth fill structure 113 feet high and approximately 3,000 feet long with about 1,500 feet being relatively low embankment. Start of construction is programmed for May 1949.


MISSOURI—SOURIS IRRIGATION PROJECT
IN NORTH DAKOTA
PROPOSED BY U. S. BUREAU OF RECLAMATION
LEGEND
RAILROADS
PROPOSED CANALS
GRADED
GRAVELED
OILED
HIGHWAYS
SCALE OF MILES
N
GROSBY POWER PLANT
CANAL
DES LACS POWER PLANT
COLLECTION CANAL
NESSON UNIT
MISSOURI RIVER
MINOT
STANLEY
KENMARE
Columbus
Noonan
Lignite
Flaxton
Noburn
Bowbells
Niobe
Kenaston
Tolley
Sherwood
Antler
Londe
Mohall
Maxbass
Newburg
Lansford
Grano
Donnybrook
Glenburn
Deering
Granville
Norwich
Simcoe
Velva
Logan
Berthold
Blaisdell
Aurelia
Coulee
Lostwood
Temple
Hamlet
Hoffland
Sanish
Souris
Des Lacs
Deep Creek
Cut Bank Creek
GT. NOR.
M. ST. P.
S. S. M.
B O T T I N
B U R K E
M O U N T R A I L
W A R D
I D E
L I A M S
Mc H

The Thunderhawk Reservoir site, located on Cedar Creek, a tributary of the Cannonball river, is approximately nine miles north of the state line and 25 miles south of the town of Elgin. The proposed dam will be an earthfill structure 62 feet in height and 2,400 feet in length. The reservoir will have a capacity of 30,000 acre-feet and will provide water for the irrigation of approximately 8,000 acres of new lands below the reservoir.

BALDHILL DAM

Projects now under construction by the Corps of Engineers in North Dakota include Baldhill dam on the Sheyenne river, located about nine miles above Valley City. Under present plans, construction will be completed during 1949 in order to provide storage for 1950 flood waters.

The reservoir is being constructed for storage, regulation and control of flood waters to be made available for municipal purposes for the cities of Valley City, West Fargo, Fargo and Moorhead and Grand Forks and East Grand Forks.

The dam will be 47 feet high and about 2,000 feet long, with four large submersible gates to regulate the water level. It will be of rolled earth-fill construction, with the reservoir side riprapped with rock to prevent damage by wave action. It will back water up 42 miles. Maximum width of the reservoir will be only six-tenths of a mile. The surface area of the normal pool will be 5,430 acres, or somewhat more than eight sections, with a maximum capacity of 66,000 acre feet.

HOMME DAM

The Corps of Army Engineers commenced construction work during 1948 on the Homme dam on the Park river, located about three miles west of the city of Park River. It is estimated that this dam will be completed and ready for storage of water by 1950.

The reservoir will store and control water to be used for municipal purposes by the cities of Park River and Grafton.

The dam will be 40 feet high and the reservoir will have a capacity of 50,000 acre feet of water.

The Homme dam will be of considerable value to local residents as a recreation center for fishing, bathing and boating.

COOPERATING AGENCIES

State and national departments and agencies with which the work of the State Water Conservation Commission is coordinated have contributed their own statement of work accomplished, which in most cases had to be condensed to bring the total within the number of pages

FLOOD CONTROL PROJECT
SHEYENNE RIVER, NORTH DAKOTA
BALDHILL RESERVOIR & CONTROL WORKS
Corps of Engineers St. Paul, Minnesota

authorized for this report. On first glance it may appear to the reader that there is an over-lapping but on further study it will be found that each department or agency has performed its particular part of the work which when coordinated with the others covers all the phases of the planning, surveying, mapping, specifications, weather and stream-flow records required for estimates, and details which make up the complete and detailed plans. This Commission is deeply indebted to the different cooperating agencies for their very fine cooperation.

CONGRESSIONAL APPROPRIATIONS FOR 1948-49

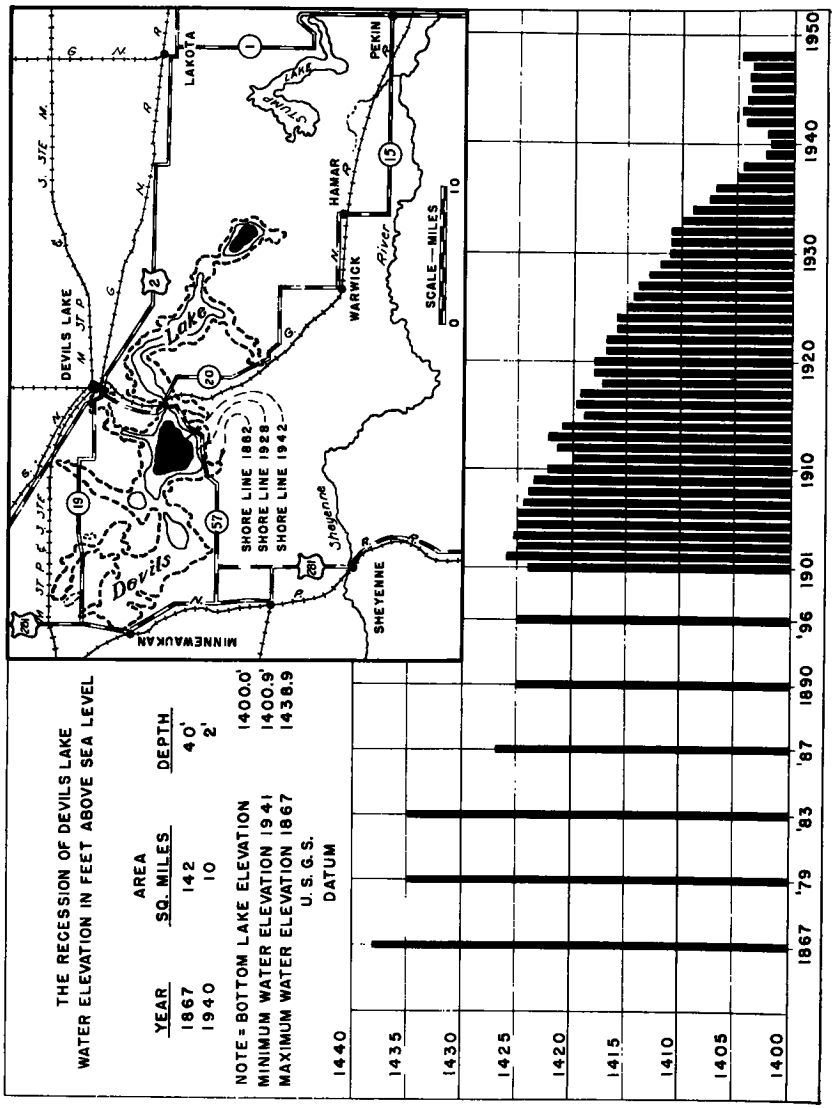
Cannonball dam, near Elgin	$ 680,000
Heart Butte dam, between Glen Ullin and Elgin	1,893,850
Dickinson dam	412,300
Missouri-Souris surveys in North Dakota, about	600,000
N. Dak. pumping units along Missouri river	42,500
Garrison Reservoir diversion studies	54,600
Little Missouri investigations	10,500
Transmission lines on Heart river	277,500
Same Williston to Garrison	926,000
Power investigations	31,000
Power operation and maintenance	42,500
Fort Clark substation near Stanton	25,000
Total	$4,995,750

By 1954 power will probably be available at Garrison dam and a good start made on construction of the transmission lines to carry power to various centers in North Dakota, at reasonable cost.

PROPOSED DAMS AND RESERVOIRS

With Approximate Figures

Name	Stream	Capacity acre-feet	Height of dam (ft.)
Heart Butte	Heart river	428,000	124
Dickinson	Heart river	25,700	49
Cannonball	Cannonball river	300,000	125
Thunderhawk	Cedar creek	Not determined	
Broncho	Knife river	Not determined	
Crosby	Souris Canal	332,000	30
Des Lacs	Des Lacs river	Not determined	30
Velva	Souris river	Diversion dam	
Sheyenne	Sheyenne river	560,000	95
Jamestown	James river	Not determined	92



Water Level Raised Slightly During Seven Wet Seasons

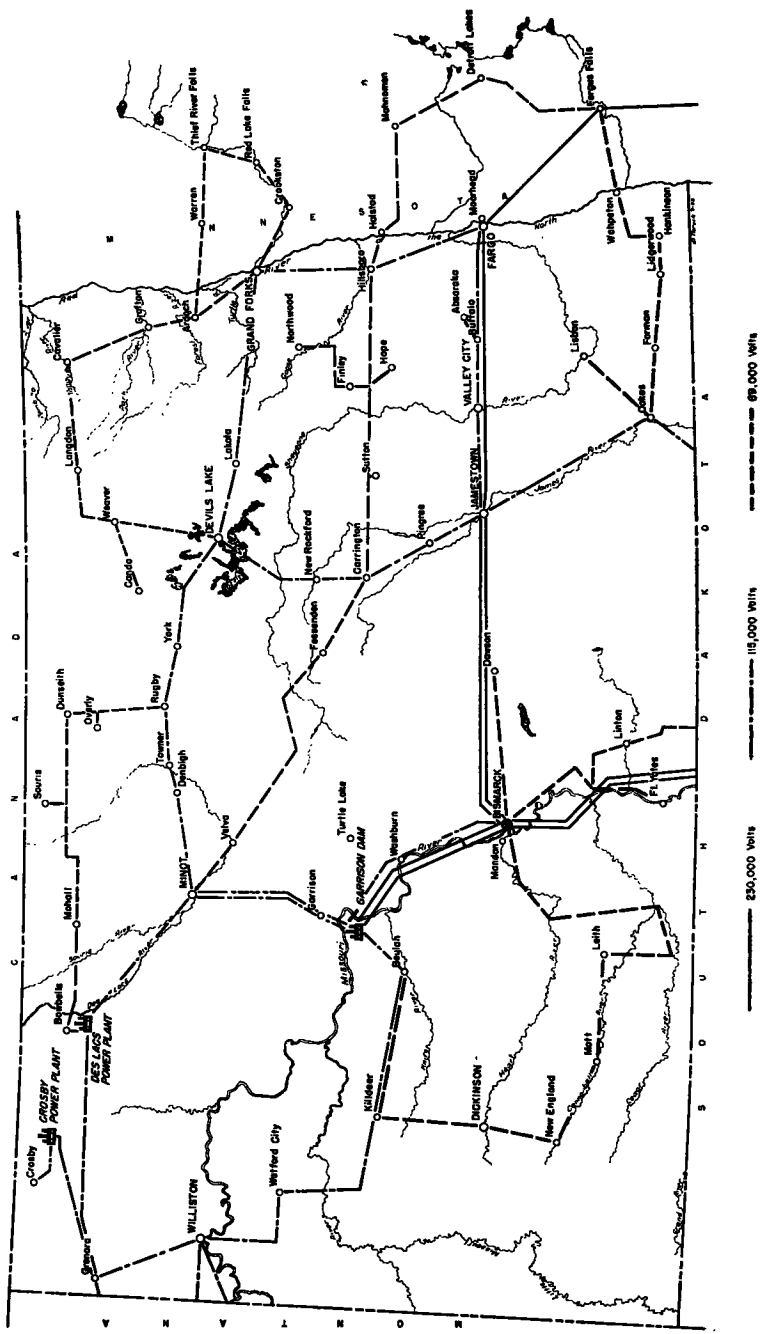
PROPOSED IRRIGATED PROJECTS

Name of Unit	Approx. acres	General Location
Heart river	14,100	Extending 100 miles west of Mandan
Cannonball and Cedar rivers	17,754	SW North Dakota—Solen to Elgin and to Thunderhawk dam on Cedar river
Knife river	15,380	Western N. Dak.—Beulah-Hazen-Stanton
Little Missouri	Not determined	Preliminary Studies and Investigations
Hancock Flats	5,400	30 miles NW of Washburn
Fort Clark	2,140	40 miles NW of Mandan
Oliver-Sanger	8,690	30 miles N of Mandan
Painted Woods	4,300	30 miles N of Bismarck
Manley	1,200	15 miles N of Mandan
Wogansport	1,750	12 miles N of Bismarck
Square Butte	2,040	8 miles N of Mandan
Burnt Creek	1,310	5 miles N of Bismarck
Bismarck	8,500	Adjoining Bismarck on south
Horsehead Flats	6,450	50 miles S of Bismarck
Winona	4,540	65 miles S of Bismarck
Missouri-Souris	1,000,000	Crosby-Minot area
New Rockford	55,500	New Rockford area
Jamestown	22,000	Jamestown area
Oakes	31,000	On James river near Oakes

PROPOSED POWER TRANSMISSION LINES

From	To	Voltage
Williston	Garrison	115,000
Bismarck	Heart river subunit	69,000
Minot	Garrison	115,000
Garrison	Bismarck	115,000
Washburn	Turtle Lake	69,000
Bismarck	Dawson	69,000
Bismarck	Jamestown	230,000
Jamestown	Fargo	115,000
Buffalo	Absaraka	69,000
Bismarck	Mobridge	230,000
Williston	Medicine Lake	115,000
Minot	Grand Forks	115,000
Devils Lake	Carrington	115,000
Carrington	Oakes	115,000
Oakes	Lisbon	69,000
Devils Lake	Grand Forks	69,000
Garrison	Bismarck #1	230,000
Jamestown	Fargo	230,000
Minot	Des Lacs	115,000
Grand Forks	Fargo	115,000
Minot	Garrison #2	115,000
Weaver	Cando	69,000
Des Lacs	Bowbells-Rugby	69,000
Souris Tap Line	N. of Newburg	69,000
Overly Tap Line		69,000
Minot	Carrington	69,000
Oakes	Wahpeton	69,000
Beulah	Heart River	69,000
Belfield	Richardton	69,000
Wahpeton	Fergus Falls	69,000
Fargo	Fergus Falls	230,000
Garrison	Bismarck #2	230,000
Bismarck	Jamestown #2	230,000

Wholesale Electric Distribution Lines Planned for North Dakota.



NORTH DAKOTA RURAL REHABILITATION CORPORATION

Since 1937, when the State Water Conservation Commission was organized, the North Dakota Rural Rehabilitation Corporation, under the management of Supreme Justice A. M. Christianson and his staff, has loaned the greater portion of funds used in the construction of the Lewis & Clark, the Sioux and the Grantier irrigation projects in McKenzie County, and in constructing and enlarging the intake for the Yellowstone Pumping Irrigation project. At a time when financing was difficult, the aid from this source enabled the Commission to demonstrate the value of irrigation in this area, and to show the increased returns from irrigated lands as compared to dry land farming.

NATIONAL RIVERS AND HARBORS CONGRESS

This organization acts in an advisory capacity to Congress. Its engineers have recommended Congressional appropriations on several of the projects in North Dakota. It promotes the sound and orderly development of our national water and land resources, a nationwide non-partisan, non-profit organization. It assists local and sectional organizations, on matters pertaining to river and harbor development, flood control, irrigation and reclamation, soil and water conservation and related subjects. Its membership is nation-wide.

FLOOD CONTROL PROJECTS

Mandan

Mandan has suffered great losses from floods of the Heart river. The Corps of Engineers studied the action of two floods and devised plans for protecting the city. Congress appropriated $334,000 for this work, on which construction is planned in 1949.

Mott

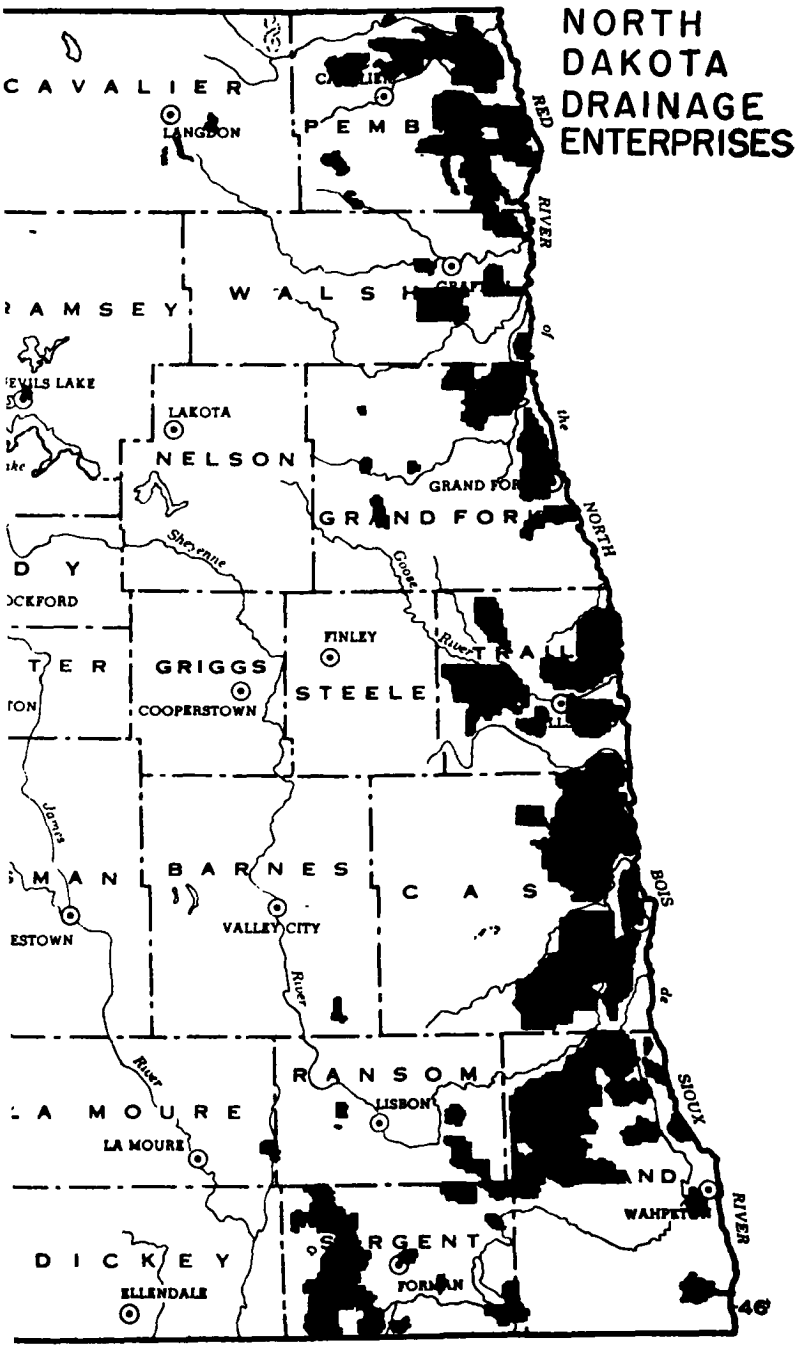
The town of Mott has had serious flood damage from the spring run-off of the Cannonball river, especially during the March floods of 1943. The engineers are studying plans for the protection of property and for preventing recurrence of this damage in future years.

Lewis and Clark

The Missouri river levee that protects the Lewis & Clark bridge and the Lewis & Clark Irrigation District is being undermined on the lower end, and if allowed to continue, may eventually destroy a large portion of the revetment work. The district engineers' office has this work under their jurisdiction and are proceeding with plans to have the repair work done before the next spring run-off.

Knife River

On the recommendation of the Corps of Engineers Congress appropriated for construction of flood control works near Beulah the sum of $87,000. and near Hazen, $35,500. to prevent further flood damage to these towns.


NORTH
DAKOTA
DRAINAGE
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CAVALIER
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the
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LAKOTA
NELSON
GRAND FOR
GRAND FOR
Sheyenne
Goose
River
DY
GRIGGS
COOPERSTOWN
FINLEY
STEELE
TRAIL
James
BARNES
VALLEY CITY
CAS
BOIS
de
SIOUX
RIVER
River
RANSOM
LISBON
LA MOURE
LA MOURE
DICKEY
ELLENDALE
SARGENT
FORMAN
WAHPETON
46

NORTH DAKOTA RECLAMATION ASSOCIATION

This Organization has had active representation in all of the meetings of importance dealing with the water problems of North Dakota. It has directors in every county and a membership of about 800 all active in the development of irrigation, water and power. It has sent representatives to Washington, D. C. who have appeared before Congressional committees when Missouri river diversion and irrigation appropriations were under consideration. It is active in conducting an educational campaign to bring to the citizens a realization of the value and need of irrigation as a stabilizing factor in agriculture and stockraising, and as a sure source of feed in years of drought. It aids in the organization of irrigation districts.

It is a member of the National Reclamation Association of which its State Director, Harry E. Polk of Williston, is national president for 1947-9. It favors an expanding program of irrigation, reclamation and water conservation for this and other states of the Missouri river basin. Oscar Lunseth of Grand Forks was President for 1947-8 and Roy Young of Mandan for 1948-9. J. I. Rovig of Mandan has been its Secretary since organization. The 1948 annual meeting was held at Dickinson on Dec. 3-4.

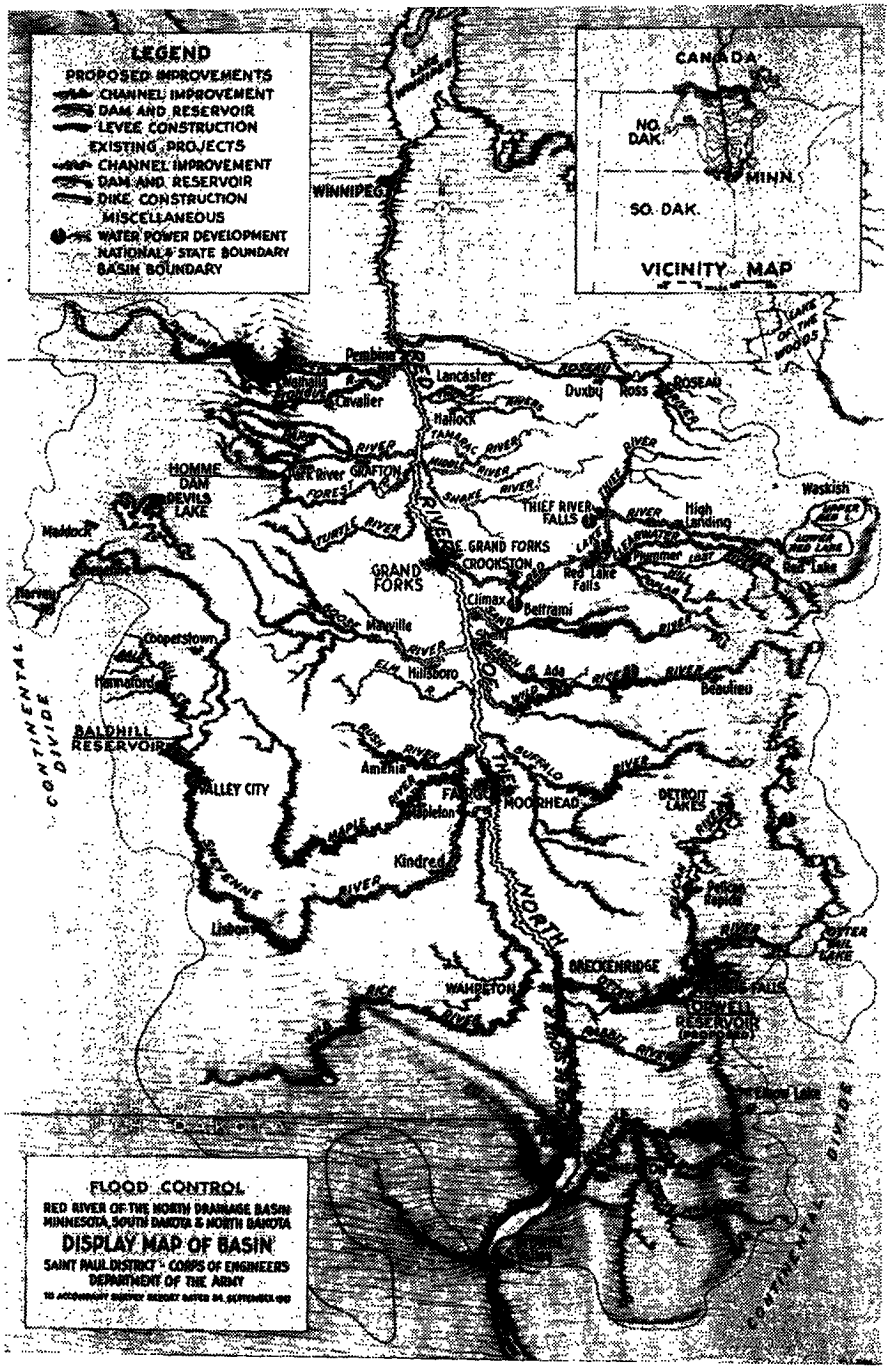
MISSOURI-SOURIS PROJECTS ASSOCIATION

A. R. Weinhandl, Minot, was named President, succeeding Halvor L. Halvorson. Its board membership was increased to include Montana representatives along the line of the proposed development. Resolutions urged Congress to provide a repayment period for irrigation construction of "not less than 67 years" instead of the 50 year repayment term now in effect. Committees on legislation, education and finance were appointed. Its purpose is to forward the construction of the project as rapidly as feasable.

RED RIVER VALLEY DRAINAGE

Of the $200,000. appropriated for drainage work or irrigation by the 1947 legislature, 75% was allocated by the State Water Conservation Commission to counties in the Red River valley on the basis of flood damage in the respective counties as reported by the U. S. Statistician, as follows:

County	Acreage Damaged	% of Acreage	Allocated
Cass	112,000	11	$ 26,000.00
Dickey	82,000	5	7,500.00
Grand Forks	41,000	4	6,000.00
LaMoure	40,000	4	6,000.00
Pembina	112,000	11	16,500.00
Ransom	50,000	5	7,500.00
Richland	272,000	26	39,000.00
Sargent	82,000	8	12,000.00
Traill	50,000	5	7,500.00
Walsh	82,000	8	12,000.00
Total allocated			$150,000.00


LEGEND
PROPOSED IMPROVEMENTS
CHANNEL IMPROVEMENT
DAM AND RESERVOIR
LEVEE CONSTRUCTION
EXISTING PROJECTS
CHANNEL IMPROVEMENT
DAM AND RESERVOIR
DIKE CONSTRUCTION
MISCELLANEOUS
WATER POWER DEVELOPMENT
NATIONAL & STATE BOUNDARY
BASIN BOUNDARY
CANADA
NO. DAK.
MINN.
SO. DAK.
VICINITY MAP
WINNIPEG
Pembina
Lancaster
Cavalier
Hallock
Duxbury
Ross
ROSEAU
HOMME DAM
DEVILS LAKE
GRAFTON
THIEF RIVER FALLS
High Landing
Waskish
Red Lake Falls
GRAND FORKS
CROOKSTON
Climax
Bejtrami
Mayville
Hillsboro
Ada
Beaulieu
Cooperstown
Hannaford
BALDHILL RESERVOIR
CONTINENTAL DIVIDE
VALLEY CITY
Amenia
Fargo
Moorhead
DETROIT LAKES
Kindred
Lisbon
WAHPETON
BRECKENRIDGE
OSWEGO RESERVOIR
FLOOD CONTROL
RED RIVER OF THE NORTH DRAINAGE BASIN
MINNESOTA, SOUTH DAKOTA & NORTH DAKOTA
DISPLAY MAP OF BASIN
SAINT PAUL DISTRICT - CORPS OF ENGINEERS
DEPARTMENT OF THE ARMY

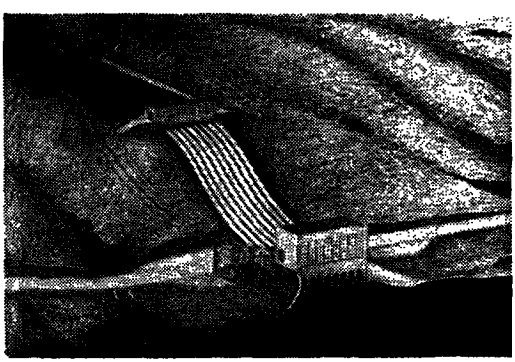
SIOUX IRRIGATION DISTRICT CANAL REPAIR

The main canal of the Sioux Irrigation District, in McKenzie County, North Dakota, was undermined by the action of the Yellowstone river waters, thus preventing the district from furnishing water from its pumping station to the irrigated acres. The State Water Conservation Commission purchased 210 additional linear feet of used 28 inch flanged dredge pipe from the Fort Peck project for $997.50, and paid $247.67 for trucking same to the Sioux Irrigation District; $481.00 for tractor, dozer and scraper work installing same, and miscellaneous materials, labor and engineer supervision, making a total of $2,026.28, including some reinforcing of the river bank by junk metal.

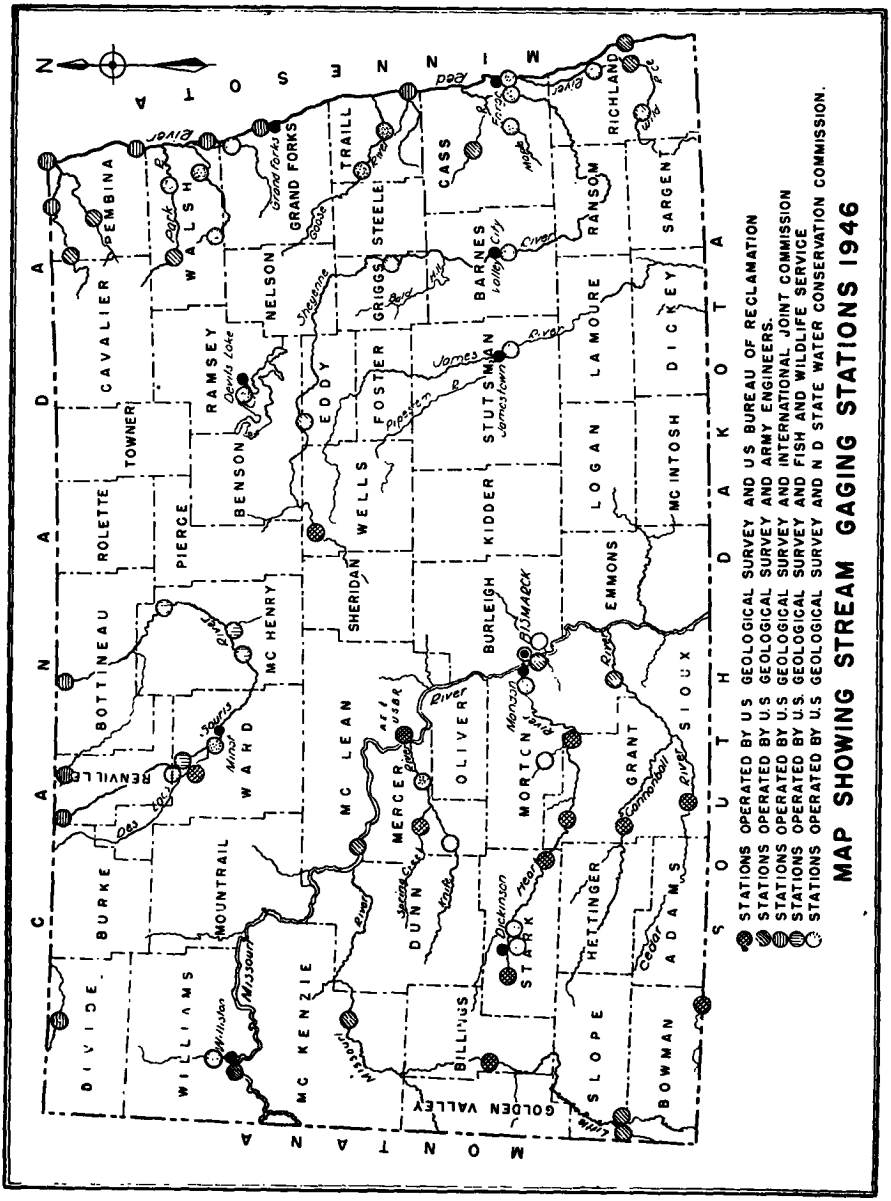
BURLINGTON IRRIGATION PROJECT

During the drought years of the thirties, the United States acquired a tract of land near the town of Burlington, in Ward County, North Dakota, which was divided into small tracts with small sets of buildings, and cultivated acreages provided with irrigation water from reservoirs in the Des Lacs river, and the tracts were used to help rehabilitate small families made destitute by the drought.

In 1947, these tracts were deeded to the State of North Dakota by the Secretary of Agriculture, including the reservoirs and lands adjacent, with the irrigation system. It was planned to use these tracts for the rehabilitation of returned soldiers of the World War who were released from the Veterans Hospital at Minot. Inspection disclosed the need of repairs on the dam and irrigation construction works, and the State Water Conservation Commission made an allocation of $2,500 for that purpose. But the press of other work and the shortage of engineers made it necessary to postpone making required repairs until next spring, when it is hoped to put the irrigation works in workable shape.



Proposed Grenora, N. D. Pumping Plant



MAP SHOWING STREAM GAGING STATIONS 1946

UNITED STATES DEPARTMENT OF THE INTERIOR

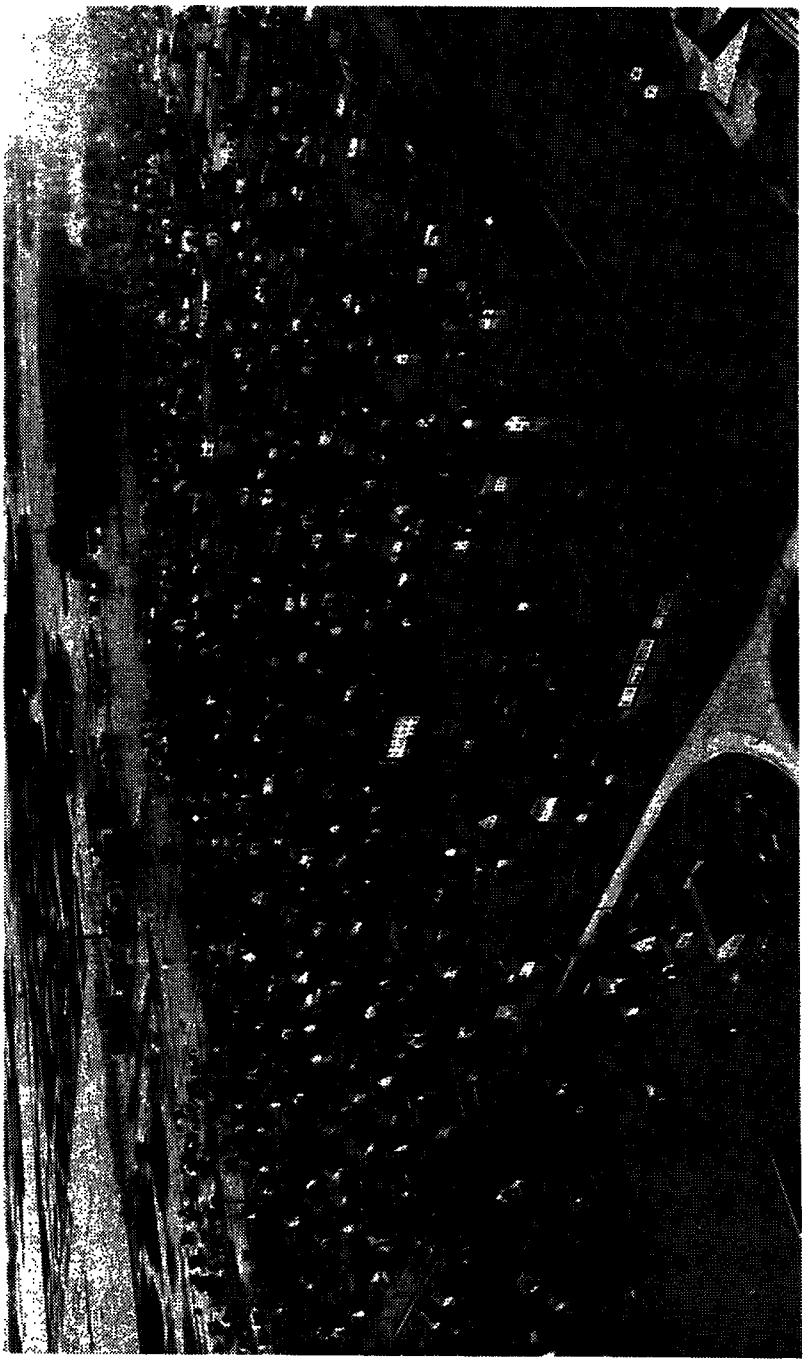
Geological Survey

WATER RESOURCES BRANCH

Surface Water Division

A state-wide stream gaging program is carried on by the Surface Water Division of the U. S. Geological Survey in order to obtain accurate records of stream flow in North Dakota. This work consists of obtaining daily and continuous river stages and actually measuring the amount of water that flows past a gaging station. From these data are computed daily flow, peak stage, peak discharge, minimum stage and minimum discharge. Monthly and annual summaries are compiled for publication. During the past two years this agency has operated twenty-two such stream-gaging stations in cooperation with the State Water Conservation Commission on a 50-50 basis with Federal and State funds. Forty-four additional stations are operated in cooperation with the U. S. Fish and Wildlife Service, Bureau of Reclamation, U. S. Department of State, and Corps of Engineers, U. S. Army. The complete records of stream flow thus obtained have been made available to the State Water Conservation Commission for its reports. Current provisional records are always available for immediate use by State agencies for any studies of flowing water.

These records are being used extensively by State and Federal agencies in the design, construction, operation, and evaluation of projects and structures pertaining to flood control, irrigation, power, municipal and industrial water supply, wildlife propagation, control of stream pollution, highway and bridge design, recreation, and other water problems. The Missouri River Development Program and Red River Improvement Program, which are inter-related and coordinated with the work of the Water Conservation Commission will divert, reroute, store, and return water to many streams throughout the state. Accurate records of flow are essential to the sound utilization of this water. Since the strength of stream flow data lies in long-term records collected without interruption, the program for the next biennium looks toward the operation of existing gaging stations and the establishment of new ones where needed for the purposes mentioned above.



Floodwaters, April, 1948, near Grafton, N. D., in the Red River Valley

MISSOURI RIVER NEAR WILLISTON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	654,800	27,600	17,000	21,090	1,297,000
November	614,600	36,100	17,200	20,490	1,219,000
December	799,160	51,000	8,960	25,780	1,585,000
January	489,200	19,700	10,100	15,780	970,300
February	208,300	11,500	5,260	7,439	413,200
March	665,400	50,600	5,680	21,460	1,320,000
April	281,130	13,500	7,590	9,371	557,600
May	420,090	18,800	7,810	13,550	833,200
June	1,258,100	68,600	21,800	41,940	2,495,000
July	1,105,600	63,300	20,200	35,660	2,193,000
August	564,900	20,500	16,000	18,220	1,120,000
September	752,000	30,200	18,800	25,070	1,492,000
Water year 1944-45	7,812,280	68,600	5,260	21,400	15,500,000

MISSOURI RIVER NEAR WILLISTON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	756,200	27,300	15,500	24,390	1,500,000
November	389,100	17,000	6,800	12,970	771,800
December	182,010	11,200	2,000	5,871	361,000
January	252,650	10,600	6,700	8,150	501,100
February	198,200	12,200	5,200	7,079	393,100
March	521,200	29,800	11,400	16,810	1,034,000
April	346,610	16,600	8,850	11,550	687,500
May	526,400	21,000	14,100	16,980	1,044,000
June	1,119,100	52,200	24,400	37,300	2,220,000
July	807,800	40,600	13,400	26,060	1,602,000
August	643,700	25,000	10,300	20,760	1,277,000
September	758,100	36,600	22,400	25,270	1,504,000
Water Year 1945-46	6,501,070	52,200	2,000	17,810	12,900,000

MISSOURI RIVER NEAR ELBOWOODS, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	692,700	29,500	18,500	22,350	1,374,000
November	603,700	23,600	10,600	20,120	1,197,000
December	813,740	66,100	6,000	26,250	1,614,000
January	522,900	24,600	6,200	16,870	1,037,000
February	257,900	14,300	6,600	9,211	511,500
March	837,700	71,000	6,400	27,020	1,662,000
April	345,870	23,200	8,390	11,530	686,000
May	429,450	19,700	8,180	13,850	851,800
June	1,220,100	69,400	18,800	40,670	2,420,000
July	1,119,100	64,400	23,900	36,100	2,220,000
August	574,200	21,800	16,200	18,520	1,139,000
September	754,300	30,400	17,300	25,140	1,496,000
Water Year 1944-45	8,171,660	71,000	6,000	22,390	16,210,000

MISSOURI RIVER NEAR ELBOWOODS, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	759,900	26,200	17,600	24,510	1,507,000
November	372,210	17,200	4,310	12,410	738,300
December	189,990	10,000	3,800	6,129	376,800
January	252,270	9,000	5,600	8,138	500,400
February	194,300	9,300	5,000	6,939	385,400
March	584,100	43,400	10,200	18,840	1,159,000
April	374,000	15,800	10,400	12,470	741,800
May	529,000	21,400	14,200	17,060	1,049,000
June	1,144,500	55,600	21,600	38,150	2,270,000
July	874,300	40,200	15,200	28,200	1,734,000
August	631,300	25,400	11,200	20,360	1,252,000
September	748,000	38,500	22,930	24,930	1,484,000
Water Year 1945-46	6,653,870	55,600	3,800	18,230	13,200,000

MISSOURI RIVER AT BISMARCK, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	704,900	28,300	19,400	22,740	1,398,000
November	643,100	25,100	17,900	21,440	1,276,000
December	498,000	21,600	9,400	16,060	987,800
January	479,800	21,600	8,700	15,480	951,700
February	344,040	20,200	7,900	12,290	682,400
March	1,016,520	78,000	7,500	32,790	2,016,000
April	380,320	23,200	9,020	12,680	754,400
May	440,550	20,200	9,090	14,210	873,800
June	1,161,200	71,300	18,300	38,710	2,303,000
July	1,228,000	70,600	26,000	39,610	2,436,000
August	580,000	24,300	15,900	18,710	1,150,000
September	733,000	31,300	16,400	24,430	1,454,000
Water Year 1944-45	8,209,430	78,000	7,500	22,490	16,280,000

MISSOURI RIVER AT BISMARCK, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	783,700	27,700	22,600	25,280	1,554,000
November	370,500	21,700	5,200	12,350	734,900
December	188,950	9,200	3,200	6,095	374,800
January	200,000	7,500	3,600	6,452	396,700
February	185,100	9,700	5,500	6,611	367,100
March	664,700	57,000	10,200	21,440	1,318,000
April	368,900	14,500	10,700	12,300	731,700
May	512,700	20,500	14,000	16,540	1,017,000
June	1,112,000	56,100	17,500	37,070	2,206,000
July	919,600	47,000	16,300	29,660	1,824,000
August	619,800	25,800	11,000	19,990	1,229,000
September	774,400	37,900	22,300	25,810	1,536,000
Water Year 1945-46	6,700,350	57,000	3,200	18,360	13,290,000

LITTLE MUDDY NEAR WILLISTON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	------	------	------	------	------
April 18-30	208	20	13	16.0	413
May	438	20	11	14.1	869
June	377.7	20	9	12.6	749
July	1,816.4	712	7	58.6	3,600
August	288.1	12	6	7.36	452
September	190.9	9.1	5	6.36	379
The period	------	------	------	------	6,460

LITTLE MISSOURI RIVER AT MARMARTH, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	1,063	65	26	34.3	2,110
November	1,422	137	2	47.4	2,820
December	31	1	1	1.0	60
January	31	1	1	1.0	60
February	623	100	1	22.2	1,240
March	71,054	9,320	3	2,292	140,900
April	7,279	600	83	242	14,440
May	3,396	367	44	110	6,730
June	8,196	1,030	69	273	16,260
July	2,034	490	10	65.6	4,030
August	2,197	351	10	70.7	4,350
September	3,021	393	12	101	5,990
Water year 1944-45	100,347	9,320	1	275	198,990

LITTLE MISSOURI AT MARMARTH, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	1,089	92	18	35.1	2,160
November	408	21	9	13.6	809
December	156	10	1	5.0	309
January	278	25	1	9.0	551
February	1,222	300	1	43.6	2,420
March	9,339	728	144	301	18,520
April	4,804	650	34	160	9,530
May	16,470	3,640	23	531	32,670
June	41,176	5,020	227	1,373	81,670
July	7,984	2,000	20	258	15,840
August	1,011	180	2	32.6	2,010
September	3,736	532	8	125	7,410
Water year 1945-46	87,673	5,020	1	240	173,900

LITTLE MISSOURI RIVER AT MEDORA, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	1,633	250	25	52.7	3,240
November	517	28	7	17.2	1,030
December	193	12	2	6.2	383
January	277	25	0	8.9	549
February	317	150	0	11.3	629
March	11,791	700	159	380	23,390
April	6,944	910	46	231	13,770
May	15,172	3,570	48	489	30,090
June	46,910	5,550	270	1,564	93,040
July	10,073	1,170	67	325	19,980
August	1,252	142	8	40.4	2,480
September	4,316	540	8	144	8,560
Water year 1945-46	99,395	5,550	0	272	197,100

LITTLE MISSOURI RIVER AT WATFORD CITY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	2,167	115	40	69.9	4,300
November	4,420	608	10	147	8,770
December	161	10	1	5.2	319
January	.....	.....	.....	.....	.....
February	4,610	1,000	.....	165	9,140
March	155,350	17,300	20	5,011	308,100
April	18,756	2,280	211	625	37,200
May	5,257	544	94	170	10,430
June	17,274	2,175	168	576	34,260
July	4,324	357	68	139	8,580
August	3,071	267	20	99.1	6,090
September	3,301	374	24	110	6,550
Water year 1944-45	218,691	17,300	.....	599	433,739

LITTLE MISSOURI NEAR WATFORD CITY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	2,797	306	36	90.2	5,550
November	409	30	5	13.6	811
December	62	.....	.....	2.0	123
January	76	.....	.....	2.5	151
February	7,883	3,000	.....	282	15,640
March	15,391	1,500	223	496	30,530
April	8,512	895	79	284	16,880
May	8,510	3,040	58	275	16,880
June	49,488	4,640	377	1,650	98,160
July	15,753	1,240	115	508	31,250
August	2,104	122	14	67.9	4,170
September	4,576	377	8	153	9,080
Water year 1945-46	115,561	4,640	.....	317	229,200

LITTLE BEAVER CREEK NEAR MARMARTH, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	120.3	8.8	2.8	3.88	239
November	240.4	19	1.0	8.01	477
December	15.9	1.0	.2	.51	32
January	3.1	.1	.1	.10	6.1
February	1,342.6	500	.1	48.0	2,660
March	12,845.4	2,100	.2	414	25,480
April	840	85	14	28.0	1,670
May	715.2	297	8.0	23.0	1,420
June	1,751.8	560	8.8	58.4	3,470
July	154.9	8.8	2.2	5.00	307
August	7.5	1.4	0	.24	15
September	38.8	4.9	0	1.29	77
Water year 1944-45	18,075.9	2,100	0	49.5	35,853.1

LITTLE BEAVER CREEK NEAR MARMARTH, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	133.4	11	2.0	4.30	265
November	110.6	8.0	2.3	3.69	219
December	31	2	0	1.0	61
January	21	2	0	.6	42
February	319	150	0	11.4	633
March	1,033	100	10	33.3	2,050
April	145.8	8.8	3.2	4.86	289
May	246.1	67	1.5	7.94	488
June	2,816.3	795	1.7	93.9	5,590
July	4,678.0	1,840	1.3	151	9,280
August	106.6	38	0	3.44	211
September	125.9	31	.1	4.20	250
Water year 1945-46	9,766.7	1,840	0	26.8	19,380

KNIFE RIVER NEAR GOLDEN VALLEY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	359	19	10	11.6	712
November	928	95	8	30.9	1,840
December	275	10	5	8.9	545
January	231	10	3	7.5	458
February	487	100	3	17.4	966
March	42,195	7,000	3	1,361	83,690
April	2,588	170	40	86.3	5,130
May	1,144	300	23	36.9	2,270
June	6,166	1,760	21	206	12,230
July	542	32	13	17.5	1,080
August	385.7	27	7.8	12.4	765
September	210.4	8.0	6.0	7.01	417
Water year 1944-45	55,511.1	7,000	3	152	110,103

KNIFE RIVER NEAR GOLDEN VALLEY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	203.6	7	6	6.57	404
November	246.7	10	6	8.22	489
December	108.2	9	1	3.49	215
January	131	8	2	4.2	260
February	1,271.5	300	1	45.4	2,520
March	7,644	1,400	32	247	15,160
April	546.0	32	9.0	18.2	1,080
May	270.3	13	6.9	8.72	536
June	1,082.4	177	4.0	36.1	2,150
July	2,109.0	588	4.8	68.0	4,180
August	124.7	35	.9	4.02	247
September	130.4	6.3	2.9	4.35	259
Water year 1945-46	13,867.8	1,400	0.9	38.0	27,500

KNIFE RIVER NEAR GOLDEN VALLEY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	474.2	39	2.9	15.3	941
November	252.8	19	4.5	8.43	501
December	189	8	5	6.1	375
January	1,783	400	3	57.5	3,540
February	5,887	1,500	17	210	11,680
March	13,849	3,000	16	447	27,470
April	11,579	1,580	42	386	22,970
May	685	37	14	22.1	1,360
June	20,436	5,630	12	681	40,530
July	2,237	291	23	72.2	4,440
August	1,508	319	12	48.6	2,990
September	322	12	10	10.7	639
Water year 1946-47	59,202.0	5,630	2.9	162	117,400

KNIFE RIVER AT HAZEN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	1,090	45	32	35.2	2,160
November	1,835	171	25	61.2	3,640
December	566	25	11	18.3	1,120
January	545	40	10	17.6	1,080
February	2,782	400	10	99.4	5,520
March	65,489	8,520	25	2,113	129,900
April	5,404	453	77	180	10,720
May	2,247	110	62	72.5	4,460
June	9,240	2,180	71	308	18,330
July	1,743	160	33	56.2	3,460
August	1,112	51	23	35.9	2,210
September	810	30	21	27.0	1,610
Water year 1944-45	92,863	8,520	10	254	184,210

KNIFE RIVER AT HAZEN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	864	30	27	27.9	1,710
November	863	33	20	28.8	1,710
December	387	24	7	12.5	768
January	455	19	10	14.7	902
February	3,145	700	6	112	6,240
March	19,350	3,300	104	624	38,380
April	1,694	104	30	56.5	3,360
May	918	34	25	29.6	1,820
June	3,824	702	18	127	7,580
July	4,735	837	23	153	9,390
August	483	31	11	15.6	958
September	614	31	14	20.5	1,220
Water year 1945-46	37,332	3,300	6	102	74,040

KNIFE RIVER AT HAZEN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	1,173	96	15	37.8	2,330
November	795	42	15	26.5	1,580
December	536	20	13	17.3	1,060
January	3,123	650	10	101	6,190
February	8,269	1,700	26	295	16,400
March	21,472	3,500	34	693	42,590
April	23,675	2,250	102	789	46,960
May	1,757	96	42	56.7	3,480
June	25,715	5,910	40	857	51,000
July	4,663	452	60	150	9,250
August	2,504	300	26	80.8	4,970
September	1,005	38	30	33.5	1,990
Water year 1946-47	94,687	5,910	10	259	187,800

SPRING CREEK AT ZAP, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	183.3	6.6	5.3	5.91	364
November	214.8	9	5	7.16	426
December	96	8	1	3.1	190
January	98	8	0	3.2	194
February	943	250	0	33.7	1,870
March	6,852	1,400	22	221	13,590
April	430.7	29	8.9	14.4	854
May	347.3	46	5.8	11.2	689
June	554.4	237	4.2	18.5	1,100
July	505.6	120	2.4	16.3	1,000
August	128.4	26	1.3	4.14	255
September	118.3	8.9	2.2	3.94	235
Water year 1945-46	10,471.8	1,400	0	28.7	20,770

SPRING CREEK AT ZAP, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	239.2	12	3.5	7.72	474
November	202.3	16	4	6.74	401
December	155	7	3	5.0	307
January	669	130	2	21.6	1,330
February	1,107	350	3	39.5	2,200
March	5,154	1,150	2	166	10,220
April	4,417	615	22	147	8,760
May	464.0	25	9.2	15.0	920
June	5,778.0	1,430	8.5	193	11,460
July	985	118	10	31.8	1,950
August	351.1	30	6.6	11.3	696
September	205.0	9.9	5.3	6.83	407
Water year 1946-47	19,726.6	1,430	2	54.0	39,120

HEART RIVER NEAR DICKINSON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
June	33.5	6.0	0.8	3.35	66
July	69.6	9.3	.7	2.25	138
August	39.5	5.6	.4	1.27	78
September	35.1	3.5	.7	1.17	70
The period 1945-1946					352

HEART RIVER NEAR LEHIGH, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	111	10	2	3.6	220
November	229	25	3	7.6	454
December	109	5	2	3.5	216
January	143	10	2	4.6	284
February	2,362	500	2	84.4	4,680
March	20,121	4,090	3	649	39,910
April	1,946	256	16	64.9	3,860
May	444	43	11	14.3	881
June	1,069.1	208	7.4	35.6	2,120
July	206.1	19	3.8	6.65	409
August	75.4	5.5	1.3	2.43	150
September	113.4	6.4	2	3.78	225
Water year 1944-45	26,929	4,090	1.3	73.8	53,409

HEART RIVER AT LEHIGH, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	122.6	5.9	2.7	3.95	243
November	122.5	5.9	2	4.08	243
December	69	4	1	2.2	137
January	42	2	1	1.4	83
February	57	8	1	2.0	113
March	244.0	10	2	7.87	484
April	135.4	8.3	2.5	4.51	269
May	152.7	13	1.4	4.93	303
June	208.4	18	2.5	6.95	413
July	172.7	13	1.4	5.57	343
August	93.2	8.6	.3	3.01	185
September	54.7	3.1	.7	1.82	108
Water year 1945-46	1,474.2	18	.3	4.04	2,920

HEART RIVER NEAR RICHARDTON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	421	16	12	13.6	835
November	1,468	642	10	48.9	2,910
December	356	20	5	11.5	706
January	209	12	3	6.7	414
February	2,497	500	2	89.1	4,950
March	65,871	9,690	10	2,125	130,700
April	6,474	981	66	216	12,840
May	1,743	116	41	56.2	3,460
June	5,582	1,980	32	186	11,070
July	1,332	294	23	42.9	2,640
August	479.9	24	7.9	15.4	952
September	297.5	13	7.6	9.91	590
Water year 1944-45	86,730.4	9,690	2	282	172,067

HEART RIVER NEAR RICHARDTON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	308.3	12	8.7	9.95	612
November	289.3	12	8	9.64	574
December	157	11	0	5.1	311
January	96	4	2	3.1	190
February	457	120	0	16.3	906
March	5,030	600	38	162	9,980
April	735	48	11	24.5	1,460
May	455.4	22	9.7	14.7	903
June	474.0	69	5.9	15.8	940
July	416.3	84	1.4	13.4	826
August	101.4	14	.5	3.27	201
September	146.0	7.8	1.8	4.87	290
Water year 1945-46	8,665.7	600	.0	23.7	17,190

HEART RIVER NEAR GLEN ULLIN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	571	24	14	18.4	1,130
November	1,081	64	16	36	2,140
December	470	22	6	15.2	932
January	300	15	6	9.7	595
February	3,096	7,000	4	111	6,140
March	81,244	10,700	15	2,621	161,100
April	8,193	850	85	273	16,250
May	2,652	250	59	85.5	5,260
June	6,014	530	40	200	11,930
July	1,437	126	34	46.4	2,850
August	806	57	11	26	1,600
September	420	20	11	14	833
Water year 1944-45	106,284	10,700	4	291	210,760

HEART RIVER NEAR GLEN ULLIN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	378	15	11	12.2	750
November	311.9	13	7.9	10.4	619
December	156	11	0	5.0	309
January	90.5	4	1	2.92	180
February	616	150	0	22.0	1,220
March	7,253	650	60	234	14,390
April	1,424	110	18	47.5	2,820
May	583	30	12	18.8	1,160
June	1,737	368	10	57.9	3,450
July	1,229.1	208	2.7	39.6	2,440
August	106.0	12	.6	3.42	210
September	191.8	16	2.7	6.39	380
Water year 1945-46	14,076.3	650	0	38.6	27,930

HEART RIVER NEAR LARK, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
June 20-30	1,818	814	18	165	3,610
July	2,446	382	14	78.9	4,850
August	167	10	3	5.4	331
September	364	20	5	12.1	722
The period 1945-1946	------	------	------	------	9,510

HEART RIVER NEAR MANDAN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	1,197	50	34	38.6	2,370
November	2,162	581	15	72.1	4,290
December	617	30	10	19.9	1,220
January	435	20	8	14.0	863
February	4,693	800	6	168	9,310
March	100,387	13,400	10	3,238	199,100
April	13,850	1,290	159	462	27,470
May	3,675	153	93	119	7,290
June	10,342	906	96	345	20,510
July	2,359	95	57	76.1	4,680
August	1,754	196	31	56.6	3,480
September	926	43	25	30.9	1,840
Water year 1944-45	142,397	13,400	6	390	282,423

HEART RIVER NEAR MANDAN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	854	29	26	27.5	1,690
November	653	31	15	21.8	1,300
December	330	20	0	10.6	655
January	22	1	0	.7	44
February	121	50	0	4.3	240
March	16,747	1,500	239	540	33,220
April	2,416	200	35	80.5	4,790
May	1,115	42	30	36.0	2,210
June	2,395	652	23	79.8	4,750
July	3,235	829	13	104	6,420
August	244	12	4	7.9	484
September	369	20	4	12.3	732
Water year 1945-46	28,501	1,500	0	78.1	56,540

GREEN RIVER NEAR GLADSTONE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	113.3	6.1	2.6	3.65	225
November	116.7	5.2	2.5	3.89	231
December	54	4	0	1.7	107
January	10	1	0	.3	20
February	138	100	0	4.9	274
March	1,365.8	130	9.8	44.1	2,710
April	198.6	8.8	4.3	6.62	394
May	124.7	5.9	2.9	4.02	247
June	134.7	12	1.6	4.49	267
July	74.5	13	.4	2.40	148
August	25.4	4.1	.1	.82	50
September	45.2	2.8	1.0	1.51	90
Water year 1945-46	2,400.9	130	0	6.58	4,760

MUDDY CREEK NEAR ALMONT, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	29.1	1.1	0.7	0.94	58
November	36.4	1.9	.6	1.21	72
December	12.8	1.0	.1	.41	25
January	2.7	.1	0	.09	5.4
February	452.4	80	0	16.2	897
March	4,511.0	700	9.0	146	8,950
April	99.8	9.4	1.5	3.33	198
May	51.8	2.4	1.2	1.67	103
June	858.6	305	1.2	28.6	1,700
July	780.0	110	1.3	25.2	1,550
August	18.9	1.0	.4	.61	37
September	24.9	1.4	.4	.83	49
Water year 1945-46	6,878.4	700	0	18.8	13,640

APPLE CREEK NEAR MENOKEN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	24.9	1.0	.6	.30	49
November	26.5	1.1	.6	.88	53
December	15.5	-------	-------	.5	31
January	9.3	-------	-------	.3	18
February	5.6	-------	-------	.2	11
March	1,898	200	1	61.2	3,760
April	649.8	40	8.5	21.7	1,290
May	163.6	8.0	2.6	5.28	324
June	60.2	3.3	.8	2.01	119
July	41.1	4.0	.5	1.33	82
August	5.9	.5	0	.19	12
September	18.1	4.0	0	.60	36
Water year 1945-46	2,918.5	200	0	8.00	5,780

CANNONBALL RIVER NEAR NEW LEIPZIG, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	380	14	10	12.2	754
November	901	94	11	30.0	1,790
December	280	13	4	9.0	555
January	167	8	4	5.4	331
February	1,602	200	4	57.2	3,180
March	21,051	4,080	15	679	41,750
April	2,030	200	26	67.7	4,030
May	923	95	20	29.8	1,830
June	3,407	343	16	114	6,760
July	1,183	263	11	38.2	2,350
August	362.3	35	4.4	11.7	719
September	129.7	10	1.7	4.32	257
Water year 1944-45	32,416	4,080	1.7	88.8	64,300

CANNONBALL RIVER NEAR NEW LEIPZIG, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	155.7	11	2.3	5.02	309
November	191.2	9.4	5.0	6.37	379
December	89	6	1	2.9	177
January	55	2	1	1.8	109
February	253	60	0	9.0	502
March	1,580	107	20	51.0	3,130
April	651.5	63	5.8	21.7	1,290
May	213.0	15	2.7	6.87	422
June	335.3	41	2.1	11.2	665
July	1,046.0	178	1.3	33.7	2,070
August	120.3	28	.3	3.88	239
September	83.4	5.8	1.0	2.78	165
Water year 1945-46	4,773.4	178	0	13.1	9,460

CANNON BALL RIVER NEAR NEW LEIPZIG, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	208.3	12	1.8	6.72	413
November	246.1	15	4	8.20	488
December	150	6	3	4.8	298
January	644	130	2	20.8	1,280
February	6,099	1,000	11	218	12,100
March	13,855	4,600	15	447	27,480
April	10,711	2,030	53	357	21,240
May	783	45	14	25.3	1,550
June	14,095	3,110	12	470	27,960
July	2,836	338	17	91.5	5,630
August	351.6	17	4.5	11.3	697
September	156.2	6.9	2.9	5.21	310
Water year 1946-47	50,135.2	4,600	1.8	137	99,450

CANNONBALL RIVER AT BREIEN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	803	50	20	25.9	1,590
November	2,195	150	21	73.2	4,350
December	656	33	8	21.2	1,300
January	397	20	7	12.8	787
February	6,620	1,000	10	236	13,130
March	42,883	6,020	55	1,383	85,060
April	7,696	750	91	257	15,260
May	2,991	214	66	96.5	5,930
June	9,671	775	66	322	19,180
July	2,051	174	28	66.2	4,070
August	1,327	128	17	42.8	2,630
September	685.9	99	7.6	22.9	1,360
Water year 1944-45	77,975.9	6,020	7	214	154,647

CANNONBALL RIVER AT BREIEN, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	236.8	9.3	6	7.64	470
November	433.6	20	8.6	14.5	860
December	377	21	5	12.2	748
January	114	5	1	3.7	226
February	207	50	1	7.4	411
March	7,961	700	100	257	15,790
April	2,541	205	28	84.7	5,040
May	952	79	13	30.7	1,890
June	2,733	590	13	91.1	5,420
July	5,693	1,280	15	184	11,290
August	406.3	65	3.0	13.1	806
September	561.7	81	1.9	18.7	1,110
Water year 1945-46	22,216.4	1,280	1	60.9	44,060

CEDAR CREEK AT PRETTY ROCK, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	162.8	15	3.0	5.25	323
November	324.3	28	5.7	10.8	643
December	167	10	2	5.4	331
January	70	3	2	2.3	139
February	2,237	300	2	79.9	4,440
March	9,179	1,500	10	296	18,210
April	1,398	164	15	46.6	2,770
May	528.6	36	6.9	17.0	1,050
June	2,519	215	12	84.0	5,000
July	211.9	33	1.5	6.84	420
August	151	45	0.3	4.87	300
September	19.1	1.5	0.1	0.64	38
Water year 1944-45	16,967.7	1,500	0.1	46.5	33,664

CEDAR CREEK AT PRETTY ROCK, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	36.8	2.0	.5	1.19	73
November	67.7	3	1	2.26	134
December	39	3	0	1.3	77
January	31	1	1	1.0	61
February	48	15	0	1.7	95
March	831	60	10	26.8	1,650
April	423.5	56	1.7	14.1	840
May	143.2	13	1.1	4.62	284
June	591.6	212	.7	19.7	1,170
July	1,299.6	184	.6	41.9	2,580
August	6.1	.5	0	.20	12
September	2.9	.7	0	.10	5.8
Water year 1945-46	3,520.4	212	0	9.64	6,980

CEDAR CREEK AT PRETTY ROCK, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	117.8	9.6	0.6	3.80	234
November	88.3	4.5	1.4	2.96	176
December	59	3	1	1.9	117
January	345.0	60	0.5	11.1	684
February	4,777	1,000	5	171	9,480
March	13,543	3,000	10	437	26,860
April	8,954	1,490	38	298	17,760
May	504.1	32	5.4	16.3	1,000
June	9,732.4	2,360	6.1	324	19,300
July	1,635.3	215	8.8	52.8	3,240
August	105.3	7.4	.9	3.40	209
September	14.5	0.9	2	.48	29
Water year 1946-47	39,876.2	3,000	2	109	79,090

NORTH FORK OF GRAND RIVER NEAR HALEY, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	25.8	1.0	.5	.83	51
November	32.1	1.7	1	1.07	64
December	22	1	0	.7	44
January	24	1	0	.8	48
February	17	2	0	.6	34
March	228.1	14	4	7.36	452
April	102.6	12	.7	3.42	204
May	57.6	2.7	1.1	1.86	114
June	236.7	56	2.0	7.89	469
July	201.8	33	1.4	6.51	400
August	12.8	1.2	.2	.41	25
September	11.1	.5	.2	.37	22
Water year 1945-46	971.6	56	0	2.66	1,930

NORTH FORK OF GRAND RIVER NEAR HALEY, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	219.3	49	.4	7.07	435
November	317.4	49	2.0	10.6	630
December	106.7	10	2	3.44	212
January	56	10	1	1.8	111
February	2,729	800	2	97.5	5,410
March	12,064	4,700	5	389	23,930
April	5,854	2,070	16	195	11,610
May	264.2	15	4.1	8.52	524
June	3,155.6	995	3.4	104	6,260
July	1,170.8	258	5.5	37.8	2,320
August	524.3	166	1.2	16.9	1,040
September	36.8	2.3	1.0	1.23	73
Water year 1946-47	26,498.1	4,700	0.4	72.6	52,600

JAMES RIVER AT JAMESTOWN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	104.7	6.0	2.0	3.38	208
November	337.0	25	4.0	11.2	668
December	372.5	50	2.5	12.0	739
January	81.6	5.0	1.5	2.63	162
February	72.3	5.0	1.5	2.58	143
March	4,131.6	324	2	133	8,190
April	2,267	128	28	75.6	4,500
May	842	57	16	27.2	1,670
June	424.1	30	1	14.1	841
July	85.2	18	0.6	2.75	169
August	127.0	33	1.2	4.10	252
September	75.6	10	1.2	2.52	150
Water year 1944-45	8,920.6	324	0.6	24.4	17,692

JAMES RIVER AT JAMESTOWN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	59.7	2.6	1.1	1.93	118
November	42.8	1.6	1.1	1.43	85
December	45.6	2.2	.9	1.47	90
January	43.4	2.2	1.0	1.40	86
February	34.6	1.6	1.0	1.24	69
March	1,885.9	149	1.2	60.8	3,740
April	2,850	159	39	95.0	5,650
May	617	35	11	19.9	1,220
June	156.2	21	.4	5.21	310
July	144.3	26	.9	4.65	286
August	82.2	9.7	.6	2.65	163
September	67.8	17	.5	2.26	134
Water year 1945-46	6,029.5	159	.4	16.5	11,950

RED RIVER AT WAHPETON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	23,362	811	706	754	46,340
November	20,786	773	416	693	41,230
December	13,206	493	236	426	26,190
January	12,057	422	331	389	23,910
February	10,248	429	319	366	20,330
March	38,741	3,740	328	1,250	76,840
April	33,987	1,4 0	758	1,133	67,410
May	25,963	1,100	706	838	51,500
June	27,488	1,170	729	916	54,520
July	9,546	620	184	308	18,930
August	4,532	202	112	146	8,990
September	4,222	208	94	141	8,370
Water year 1944-45	224,138	3,740	94	614	444,560

RED RIVER AT WAHPETON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	6,957	283	174	224	13,800
November	7,804	361	140	260	15,480
December	6,868	294	176	222	13,620
January	5,882	224	157	190	11,670
February	3,569	160	66	127	7,080
March	25,515	3,030	176	823	50,610
April	33,408	1,510	643	1,114	66,260
May	18,739	748	467	604	37,170
June	10,875	452	305	362	21,570
July	22,198	949	452	716	44,030
August	18,846	731	493	608	37,380
September	15,039	561	452	501	29,830
Water year 1945-46	175,700	3,030	66	481	348,500

RED RIVER AT WAHPETON, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	18,513	784	414	597	36,720
November	17,499	740	350	583	34,710
December	14,960	600	330	483	29,670
January	12,810	480	350	413	25,410
February	9,660	420	270	345	19,160
March	15,080	900	260	486	29,910
April	60,632	4,540	780	2,021	120,300
May	50,430	1,800	1,430	1,627	100,000
June	44,610	1,720	1,210	1,487	88,480
July	33,561	1,470	302	1,083	66,570
August	7,184	368	167	232	14,250
September	6,209	255	135	207	12,320
Water year 1946-47	291,148	4,540	135	798	577,500

RED RIVER AT FARGO, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	23,099	779	709	745	46,030
November	21,904	827	469	730	43,650
December	15,817	767	323	510	31,570
January	13,359	484	383	431	26,690
February	10,898	432	357	389	21,790
March	87,224	7,650	344	2,814	173,200
April	50,120	2,080	1,210	1,671	99,590
May	30,977	1,420	789	999	61,640
June	33,222	1,520	795	1,107	66,120
July	11,638	789	218	375	23,370
August	4,805	215	102	155	9,800
September	4,032	202	89	134	8,260
Water year 1944-45	307,095	7,650	89	841	611,691

RED RIVER OF THE NORTH AT FARGO, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Observed Maximum	Observed Minimum	Adjusted for Diversion Mean	Adjusted for Diversion Run-off in Acre-Feet
1945-1946					
October	6,767	268	177	223	13,690
November	7,446	332	151	253	15,030
December	6,802	295	174	224	13,760
January	5,792	218	162	191	11,750
February	3,159	157	80	117	6,510
March	48,061	5,880	151	1,555	95,590
April	40,425	1,820	836	1,352	80,440
May	19,833	795	557	644	39,620
June	12,613	527	345	425	25,320
July	21,873	935	407	712	43,800
August	18,566	745	502	606	37,240
September	15,113	542	454	509	30,310
Water year 1945-46	206,450	5,880	80	571	413,100

RED RIVER OF THE NORTH AT FARGO, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Observed Maximum	Observed Minimum	Adjusted for Diversion Mean	Adjusted for Diversion Run-off in Acre-Feet
1946-1947					
October	17,927	712	436	584	35,900
November	16,056	676	344	541	32,170
December	15,202	582	353	496	30,500
January	12,829	450	361	419	25,780
February	9,487	428	270	344	19,120
March	15,909	1,200	290	519	31,880
April	106,120	9,200	1,080	3,543	210,800
May	58,300	2,260	1,600	1,887	116,000
June	48,370	1,960	1,380	1,619	96,310
July	35,614	1,490	450	1,158	71,180
August	7,669	420	159	256	15,760
September	6,052	247	138	208	12,400
Water year 1946-47	349,535	9,200	138	964	697,800

a No gage-height record; discharge computed on basis of record for station at Wahpeton.

RED RIVER AT HALSTAD, MINNESOTA
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	------	------	------	------	------
April	139,330	6,840	3,970	4,976	276,400
May	71,310	3,670	1,510	2,300	141,400
June	49,700	2,260	1,260	1,657	98,580
July	------	------	------	------	------
August	------	------	------	------	------
September	------	------	------	------	------
Water year 1944-45	260,340	6,840	1,260	------	516,380

RED RIVER OF THE NORTH AT HALSTAD, MINN.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March 31	8,610	------	------	------	17,080
April	113,490	7,440	1,820	3,783	225,100
May	43,780	1,750	1,160	1,412	86,840
June	26,377	1,180	669	879	52,320
July 1-3	3,750	------	------	------	7,440
August	------	------	------	------	------
September	------	------	------	------	------
The period 1945-46	------	------	------	------	388,800

RED RIVER OF THE NORTH AT HALSTAD, MINN.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	------	------	------	------	------
April 12-30	297,780	24,400	4,340	15,670	590,600
May	96,230	4,220	2,380	3,104	190,900
June	103,610	7,440	2,030	3,454	205,500
July	45,993	2,040	714	1,484	91,230
August	11,220	669	242	362	22,250
September	------	------	------	------	------
The period	------	------	------	------	1,100,000

RED RIVER AT GRAND FORKS, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	74,150	2,680	2,120	2,392	147,100
November	69,640	3,040	1,760	2,321	138,100
December	51,710	2,240	1,140	1,668	102,600
January	42,700	1,430	1,330	1,377	84,690
February	38,440	1,420	1,260	1,373	76,240
March	281,880	21,000	1,230	9,093	559,100
April	365,790	18,300	9,720	12,190	725,500
May	181,720	9,540	3,230	5,862	360,400
June	94,830	3,650	2,480	3,161	188,100
July	50,450	2,410	1,220	1,627	100,100
August	31,537	1,220	851	1,017	62,550
September	40,080	1,860	933	1,336	79,500
Water year 1944-45	1,322,927	21,000	851	3,624	2,623,980

RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	52,570	1,950	1,520	1,696	104,300
November	36,390	1,630	950	1,213	72,180
December	29,510	1,200	830	952	58,530
January	26,760	900	795	863	53,080
February	21,485	900	685	767	42,610
March	200,000	21,900	775	6,452	396,700
April	286,220	19,100	4,410	9,541	567,700
May	107,460	4,190	2,780	3,466	213,100
June	61,380	2,660	1,700	2,046	121,700
July	69,400	3,830	1,490	2,239	137,700
August	38,030	1,460	1,100	1,227	75,430
September	35,650	1,420	1,020	1,188	70,710
Water year 1945-46	964,855	21,900	685	2,643	1,914,000

RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	53,970	2,000	1,350	1,741	107,000
November	43,150	1,800	900	1,438	85,590
December	34,470	1,220	1,040	1,112	68,370
January	33,310	1,160	950	1,075	66,070
February	23,490	990	740	839	46,590
March	42,700	4,300	740	1,377	84,690
April	588,700	34,900	4,800	19,620	1,168,000
May	232,060	13,400	5,080	7,486	460,300
June	309,640	19,000	4,660	10,320	614,200
July	132,910	6,710	1,850	4,287	263,600
August	43,790	1,700	1,260	1,413	86,860
September	41,790	1,620	1,220	1,393	82,890
Water year 1946-47	1,579,980	34,900	740	4,329	3,134,000

RED RIVER OF THE NORTH AT GRAND FORKS, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1947-1948					
October	49,560	1,660	1,500	1,599	98,300
November	39,890	1,750	760	1,330	79,120
December	38,890	1,460	1,150	1,255	77,140
January	34,300	1,240	910	1,106	68,030
February	26,480	970	870	913	52,520
March	32,260	1,580	880	1,041	63,990
April	593,960	34,000	1,690	19,800	1,178,000
May	242,330	12,300	4,100	7,817	480,700
June	75,070	3,990	1,840	2,502	148,900
July	52,520	2,630	1,250	1,694	104,200
August	35,860	1,460	1,000	1,157	71,130
September	26,747	1,120	647	892	53,050
Water year 1947-48	1,247,867	34,000	647	3,409	2,475,000

RED RIVER OF THE NORTH AT OSLO, MINN.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March 23-31	201,800	24,000	------	22,420	400,300
April	387,190	21,800	9,920	12,910	768,000
May	185,450	9,680	3,500	5,982	367,800
June	99,410	3,730	2,690	3,314	197,200
July 1-9	20,570	2,580	------	2,286	40,800
August	------	------	------	------	------
September	------	------	------	------	------
The period	------	------	------	------	1,774,000

RED RIVER OF THE NORTH AT OSLO, MINN.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	------	------	------	------	------
April	307,010	21,900	4,620	10,230	608,900
May	107,610	4,280	2,830	3,471	213,400
June	62,220	2,750	1,720	2,074	123,400
July	------	------	------	------	------
August	------	------	------	------	------
September	------	------	------	------	------
The period 1945-46	------	------	------	------	945,700

RED RIVER OF THE NORTH AT OSLO, MINN.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	------	------	------	------	------
April 7-30	559,220	33,800	7,800	23,300	1,109,000
May	241,810	15,900	5,170	7,800	479,600
June	320,820	19,400	4,750	10,690	636,300
July	139,550	6,710	2,200	4,502	276,800
August	------	------	------	------	------
September	------	------	------	------	------
The period	------	------	------	------	2,502,000

RED RIVER OF THE NORTH AT DRAYTON, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	------	------	------	------	------
April	476,200	24,600	11,100	15,870	944,500
May	210,170	11,600	3,990	6,780	416,900
June	105,120	3,940	2,720	3,504	208,500
July	25,880	2,750	1,860	2,353	51,330
August	------	------	------	------	------
September	------	------	------	------	------
The period	------	------	------	------	1,621,000

RED RIVER OF THE NORTH AT DRAYTON, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March 26-31	131,600	23,000	20,300	21,930	261,000
April	373,000	22,900	4,990	12,430	739,800
May	114,310	4,780	2,970	3,687	226,700
June	63,950	2,870	1,670	2,132	126,800
July	------	------	------	------	------
August	------	------	------	------	------
September	------	------	------	------	------
The period	------	------	------	------	1,354,000

RED RIVER OF THE NORTH AT DRAYTON, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	------	------	------	------	------
April 14-30	429,100	29,300	17,300	25,240	851,100
May	321,150	26,100	5,400	10,360	637,000
June	334,320	19,400	4,720	11,140	663,100
July	163,270	7,790	3,140	5,267	323,800
August	54,630	2,740	1,390	1,762	108,400
September	------	------	------	------	------
The period Apr. 14 to Aug. 31	------	------	------	------	2,583,000

RED RIVER AT EMERSON, MANITOBA
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	90,100	3,310	2,520	2,910	178,700
November	120,790	6,240	2,510	4,030	239,600
December	84,710	4,290	1,530	2,730	168,000
January	40,100	1,520	1,180	1,290	79,540
February	38,220	1,420	1,260	1,370	75,810
March	282,760	29,300	1,300	9,120	560,800
April	604,400	29,400	13,700	20,100	1,199,000
May	268,020	13,800	5,000	8,650	531,600
June	121,300	4,780	3,220	4,040	240,600
July	67,800	3,190	1,670	2,190	134,500
August	40,570	1,760	1,120	1,310	80,470
September	53,290	2,400	1,030	1,780	105,700
Water year 1944-45	1,812,070	29,400	1,030	4,960	3,594,000

RED RIVER OF THE NORTH AT EMERSON, MANITOBA
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	61,240	2,370	1,700	1,980	121,500
November	41,944	1,750	994	1,400	83,200
December	30,631	1,140	900	988	60,760
January	29,293	1,000	886	945	58,100
February	22,145	952	644	791	43,920
March	177,888	22,900	701	5,740	352,800
April	439,200	24,100	5,940	14,600	871,100
May	127,690	5,660	3,170	4,120	253,300
June	66,690	3,060	1,780	2,220	132,300
July	75,690	4,310	1,680	2,400	150,100
August	39,470	1,660	1,120	1,270	78,290
September	35,000	1,410	1,030	1,170	69,420
Water year 1945-46	1,146,881	24,100	644	3,140	2,275,000

RED RIVER OF THE NORTH AT EMERSON, MANITOBA
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	51,490	1,920	1,290	1,660	102,100
November	48,500	1,850	1,230	1,620	96,200
December	36,250	1,390	1,010	1,170	71,900
January	31,953	1,110	933	1,030	63,380
February	25,123	987	804	897	49,830
March	32,776	3,050	813	1,060	65,010
April	534,900	28,400	3,730	17,800	1,061,000
May	370,240	28,100	5,670	11,900	734,400
June	361,510	20,900	5,250	12,100	717,000
July	179,320	9,090	3,230	5,780	355,700
August	62,910	3,000	1,640	2,030	124,800
September	47,130	1,740	1,400	1,570	93,480
Water year 1946-47	1,782,102	28,400	804	4,880	3,535,000

BOISE DE SIOUX RIVER NEAR WHITE ROCK, S. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	87.4	11	0	2.82	173
November	37.8	5.7	0	1.26	75
December	3.0	------	------	0.10	6
January	0	0	0	0	0
February	0	0	0	0	0
March	491.9	104	0	15.9	976
April	11,256	875	227	375	22,330
May	1,284	255	9.0	41.4	2,550
June	6,419	487	32	214	12,730
July	182.1	12	3	5.87	361
August	99.4	9.5	0.8	3.21	197
September	34.6	2.6	0.2	1.15	69
Water year 1944-45	19,895.2	875	0	54.5	39,467

BOIS DE SIOUX RIVER NEAR WHITE ROCK, S. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	96.4	4.9	1.7	3.11	191
November	33.8	3.8	.2	11.3	67
December	8.5	1.2	0	.27	17
January	0	0	0	0	0
February	0	0	0	0	0
March	872.0	130	0	28.1	1.730
April	15,914.0	825	7.5	530	31,560
May	767.1	90	3.8	24.7	1,520
June	393.8	36	5.3	13.1	781
July	1,199.1	185	2.1	38.7	2,380
August	129.3	7.5	2.0	4.17	256
September	69.5	3.8	1.6	2.32	138
Water year 1945-46	19,483.5	825	0	53.4	38,640

WILD RICE NEAR MANTADOR, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	451.1	24	8.2	14.6	895
November	535.2	29	6.7	17.8	1,060
December	96.6	------	------	3.12	192
January	------	------	------	------	------
February	------	------	------	------	------
March	11,586	924	0.0	374	22,980
April	8,310	479	214	277	16,480
May	2,915	205	42	94	5,780
June	3,003	162	25	100	5,960
July	299.2	24	3.6	9.65	593
August	55.9	6.2	0	1.80	111
September	46.5	8.0	0	1.55	92
Water year 1944-45	27,298.5	924	0	74.8	54,143

WILD RICE RIVER NEAR MANTADOR, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	35.4	2.2	.6	1.14	70
November	69.6	4.8	.4	2.32	138
December	16.1	1.5	0	.52	32
January	0	0	0	0	0
February	0	0	0	0	0
March	3,254	290	0	105	6,450
April	4,050	247	35	135	8,030
May	453.9	31	5.9	14.6	900
June	168.9	18	1.5	5.63	335
July	572.7	73	3.6	18.5	1,140
August	11.6	2.6	0	.37	23
September	29.6	3.6	0	.99	59
Water year 1945-46	8,661.8	290	0	23.7	17,180

WILD RICE RIVER NEAR ABERCROMBIE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	64.5	4.4	1.1	2.08	128
November	78.6	3.6	1.8	2.62	156
December	21.5	1.9	0	.69	43
January	0	0	0	0	0
February	0	0	0	0	0
March	16,663	2,300	0	538	33,050
April	6,077	343	69	203	12,050
May	836	58	11	27.0	1,660
June	246.3	24	3.6	8.21	489
July	947.2	84	9.2	30.6	1,880
August	78.4	17	0	2.53	156
September	3.6	.8	0	.12	7.1
Water year 1945-46	25,016.1	2,300	0	68.5	49,620

WILD RICE RIVER NEAR ABERCROMBIE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	609	26	15	19.6	1,210
November	972	74	13	32.4	1,930
December	396.5	28	1.9	12.8	786
January	27.6	1.8	.6	.89	55
February	35.1	1.4	.8	1.25	70
March	31,181.7	2,800	1.4	1,010	61,850
April	12,374	780	261	412	24,540
May	4,041	261	60	130	8,020
June	4,723	433	40	157	9,370
July	490.5	38	7.7	15.8	973
August	129.9	7.7	.6	4.19	258
September	65.8	9.7	0	2.19	131
Water year 1945	55,046.1	2,800	0	151	109,200

ANTELOPE CREEK AT DWIGHT, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	22.6	1.3	0.4	0.73	45
November	117.7	13	.5	3.92	233
December	10.9	2.7	0	135	22
January	0	0	0	0	0
February	0	0	0	0	0
March	5,351	850	0	173	10,610
April	786.6	55	9.6	26.2	1,560
May	112.9	11	.8	3.64	224
June	488.5	104	.1	16.3	969
July	0	0	0	0	0
August	0	0	0	0	0
September	0	0	0	0	0
Water year 1944-45	6,890.2	850	0	18.9	13,660

ANTELOPE CREEK AT DWIGHT, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
March	6,742	1,260	.....	217	13,370
April	312.8	32	.2	10.4	620
May	1.5	.4	0	.05	3.0
June	0	0	0	0	0
July	210.6	34	0	6.79	418
August	1.1	.3	0	.04	2.2
September	0	0	0	0	0
Water year 1945-46	7,268.0	1,260	0	19.9	14,410

SHEYENNE RIVER NEAR HARVEY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
November	8.8	.6	0	.29	17
December	12.4	.7	.2	.40	25
January	3.0	.2	0	.10	6.0
February	0	0	0	0	0
March	718.1	119	0	23.2	1,420
April	214.8	23	2.4	7.16	426
May	35.5	2.0	0	1.15	70
June	5.8	3.1	0	.19	12
July	69.9	8.4	.2	2.25	139
August	0.4	.2	0	.01	.8
September	0	0	0	0	0
Water year 1945-46	1,068.7	119	0	2.93	2,120

SHEYENNE RIVER AT SHEYENNE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	9.6	2.0	0	0.31	19
November	302.2	27	0	10.1	599
December	162.3	10	2.5	5.24	322
January	12.5	2	0	0.4	25
February	5.6	------	------	0.2	11
March	6,614.2	901	0.2	213	13,120
April	1,058.8	84	7.4	35.3	2,100
May	328	25	3.0	10.6	651
June	221.1	16	1.6	7.37	439
July	28.7	3.6	0	0.93	57
August	117.9	16	0	3.8	234
September	1.2	------	------	0.4	2.4
Water year 1944-45	8,862.1	901	0	24.3	17,579.4

SHEYENNE RIVER AT SHEYENNE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	3.7	1.0	0	0.12	7.3
November	.5	.5	0	.02	1.0
December	24.1	2.0	0	.78	48
January	14.6	1.0	0	.47	29
February	0	0	0	0	0
March	7,943	1,120	0	256	15,750
April	1,557.6	157	6.6	51.9	3,090
May	186.9	22	.3	6.03	371
June	84.2	14	0	2.81	167
July	2,274.9	443	2.4	73.4	4,510
August	179.8	27	.1	5.80	357
September	41.0	14	0	1.37	81
Water year 1945-46	12,310.3	1,120	0	33.7	24,410

SHEYENNE RIVER NEAR COOPERSTOWN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	1,037	------	------	------	2,060
April	3,845	278	64	128	7,630
May	2,424	100	61	78.2	4,810
June	1,968	114	26	65.6	3,900
July	613	37	11	19.8	1,220
August	265.8	24	2.6	8.57	527
September	306.3	29	2.0	10.2	608
Water year 1944-45	10,459.1	278	2.0	------	20,755

SHEYENNE RIVER NEAR COOPERSTOWN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	289.8	28	3.4	9.35	575
November	385	18	11	12.8	764
December	262.4	11	5.6	8.46	520
January	292.5	11	8.1	9.44	580
February	103.9	10	1.9	3.71	206
March	11,484.3	958	6.5	370	22,780
April	8,921	964	70	297	17,690
May	1,641	68	37	52.9	3,250
June	722	40	15	24.1	1,430
July	1,919	348	10	61.9	3,810
August	1,052.9	142	7.6	34.0	2,090
September	389.9	25	4.5	13.0	773
Water year 1945-46	27,463.7	964	1.9	75.2	54,470

SHEYENNE RIVER NEAR COOPERSTOWN, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	722	35	17	23.3	1,430
November	545	26	13	18.2	1,080
December	298	15	6	9.6	591
January	240	30	5	7.7	476
February	125	10	2	4.5	248
March	4,704	490	1	152	9,330
April	12,466	1,100	104	416	24,730
May	2,067	101	52	66.7	4,100
June	1,931	193	44	64.4	3,830
July	909	77	12	29.3	1,800
August	450.1	28	5.5	14.5	893
September	161.4	18	1.9	5.38	320
Water year 1946-47	24,618.5	1,100	1	67.4	48,830

SHEYENNE RIVER AT VALLEY CITY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	659	31	16	21.3	1,310
November	1,640	99	20	54.7	3,250
December	961	53	11	31.0	1,910
January	320.4	12	7.8	10.3	636
February	346.2	27	9.0	12.4	687
March	13,877	1,010	10	448	27,520
April	5,041	375	76	168	10,000
May	2,826	113	71	91.2	5,610
June	2,383	121	34	79.4	4,730
July	822	39	16	26.5	1,630
August	799.4	113	0.8	25.8	1,590
September	363	29	1.0	12.1	720
Water year 1944-45	30,038	1,010	0.8	82.3	59,593

SHEYENNE RIVER AT VALLEY CITY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	263.9	24	2.5	8.51	523
November	438	21	10	14.6	869
December	302.3	14	5.3	9.75	600
January	313.2	11	9.2	10.1	621
February	141.8	12	1.8	5.06	281
March	12,761.6	1,130	2.8	412	25,310
April	11.425	976	88	381	22,660
May	2,174	88	50	70.1	4,310
June	1,107	84	19	36.9	2,200
July	1,432.6	267	3.0	46.2	2,840
August	1,443.5	228	3.7	46.6	2,860
September	607.9	43	4.9	20.3	1,210
Water year 1945-46	32,410.8	1,130	1.8	88.8	64,280

SHEYENNE RIVER AT VALLEY CITY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	1,101	62	19	35.5	2,180
November	742	35	16	24.7	1,470
December	355.8	17	7.0	11.5	706
January	473.7	68	5.3	15.3	940
February	241.2	21	2.6	8.61	478
March	7,159.3	800	1.8	231	14,200
April	18,886	1,890	149	630	37,460
May	2,699	146	60	87.1	5,350
June	2,857	199	50	95.2	5,670
July	1,099.8	81	9.8	35.5	2,180
August	395.4	38	4.3	12.8	784
September	47.6	4.1	.9	1.59	94
Water year 1946-47	36,057.8	1,890	.9	98.8	71,510

SHEYENNE RIVER AT WEST FARGO, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	2,444	97	59	78.8	4,850
November	2,775	120	66	92.5	5,500
December	1,883	85	40	60.7	3,730
January	1,380	68	34	44.5	2,740
February	1,317	50	40	47.0	2,610
March	17,139	1,330	40	553	33,990
April	13,689	975	226	456	27,150
May	5,841	221	149	188	11,590
June	4,804	199	110	160	9,530
July	2,446	109	62	78.9	4,850
August	1,959	95	42	63.2	3,890
September	1,130	52	31	37.7	2,240
Water year 1944-45	56,807	1,330	31	156	112,670

SHEYENNE RIVER AT WEST FARGO, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	1,151	53	30	37.1	2,280
November	1,135	50	28	37.8	2,250
December	823	34	22	26.5	1,630
January	894	32	26	28.8	1,770
February	1,021	42	31	36.5	2,030
March	10,309	1,630	42	333	20,450
April	20,626	1,390	230	688	40,910
May	4,694	219	117	151	9,310
June	3,448	172	93	115	6,840
July	2,747	126	48	88.6	5,450
August	2,301	161	36	74.2	4,560
September	1,260	62	30	42.5	2,500
Water year 1945-46	50,409	1,630	22	138	99,980

MAPLE RIVER AT MAPLETON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	157.0	8.7	3.4	5.06	309
November	434.9	28	6.3	14.5	863
December	150.0	11	1.3	4.84	298
January	10.2	1.5	0	.33	20
February	0	0	0	0	0
March	2,888	230	0	93.2	5,730
April	2,593	315	38	86.4	5,140
May	780	43	14	25.2	1,550
June	495.1	35	3.0	16.5	982
July	111.5	22	.8	3.60	221
August	104.6	6.6	.3	3.37	207
September	14	3	.1	.47	28
Water year 1944-45	7,738.3	315	0	21.2	15,350

MAPLE RIVER AT MAPLETON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	40.8	3.6	0.6	1.32	81
November	70.5	6.6	.7	2.35	140
December	24.6	1.4	.1	.79	49
January	3.1	.1	.1	.10	6.1
February	.9	.1	0	.03	1.8
March	3,591.1	527	.2	116	7,120
April	2,094	149	18	69.8	4,150
May	273.5	17	6.3	8.82	542
June	281.2	21	5.5	9.37	558
July	136.8	11	.3	4.41	271
August	1.3	.2	0	.04	2.6
September	3.8	1.9	0	.13	7.5
Water year 1945-46	6,521.6	527	0	17.9	12,930

RUSH RIVER AT AMENIA, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
July 8-31	6.8	1.1	0	.28	13
August	0	0	0	0	0
September	0	0	0	0	0
The period	------	------	------	------	13

GOOSE RIVER NEAR PORTLAND, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
March	3,508	520	0	113	6,960
April	546.6	50	4.5	18.2	1,080
May	86.8	3.8	1.4	2.80	172
June	26.3	2.6	0	.88	52
July	21.1	2.7	0	.68	42
The period 1945-46	4,188.8	520	0	11.5	8,310

GOOSE RIVER NEAR PORTLAND, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	0	0	0	0	0
November	0	0	0	0	0
December	0	0	0	0	0
January	0	0	0	0	0
February	0	0	0	0	0
March	1,617	260	0	52.2	3,210
April	1,949.3	200	6.5	65.0	3,870
May	92.9	6.1	.8	3.00	184
June	441.7	41	1.5	14.7	876
July	21.1	1.8	0	.68	42
August	.6	.3	0	.02	1.2
September	0	0	0	0	0
Water year 1946-47	4,122.6	260	0	11.3	8,180

GOOSE RIVER AT HILLSBORO, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	88.9	4.8	1.4	2.87	176
November	403.6	36.0	1.8	13.5	801
December	173.5	14.0	1.4	5.6	344
January	20.5	1.4	0.4	0.66	41
February	18.0	0.9	0.4	0.64	36
March	3,052.5	283.0	0.2	98.5	6,050
April	1,215.0	90.0	18.0	40.5	2,410
May	564.0	27.0	13.0	18.2	1,120
June	513.2	27.0	6.4	17.1	1,020
July	185.5	38.0	0.9	5.98	368
August	40.4	4.1	0.4	1.3	80
September	32.6	2.8	0.0	1.09	65
Water year 1944-45	6,307.7	283.0	0.0	17.3	12,511

GOOSE RIVER AT HILLSBORO, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	51.4	2.8	.7	1.66	102
November	15.8	.9	.3	.53	31
December	15.8	.9	.4	.51	31
January	14.6	.7	.4	.47	29
February	15.6	2.3	.4	.56	31
March	6,504.2	1,200	.3	210	12,900
April	1,548	122	18	51.6	3,070
May	496	27	11	16.0	984
June	273.2	27	3.8	9.11	542
July	274.5	23	2.2	8.85	544
August	16.8	1.9	0	.54	33
September	25.1	4.8	0	.84	50
Water year 1945-46	9,251.0	1,200	0	25.3	18,350

GOOSE RIVER AT HILLSBORO, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	42.3	4.1	0.6	1.36	84
November	43.9	2.8	.9	1.46	87
December	20.8	1.4	.2	.67	41
January	6.7	.4	.1	.22	13
February	3.9	.4	0	.14	7.7
March	3,765.5	650	0	121	7,470
April	11,841	1,660	72	395	23,490
May	1,187	68	14	38.3	2,350
June	1,559	120	12	52.0	3,090
July	284.3	20	2.6	9.17	564
August	60.2	2.9	1.4	1.94	119
September	26.6	1.4	.7	.89	53
Water year 1946-47	18,841.2	1,660	0	51.6	37,370

TURTLE RIVER AT MANVEL, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	64.3	3.7	1.3	2.07	128
November	54.2	4.9	.2	1.81	108
December	11.4	.9	.1	.37	23
January	3.1	.1	.1	.10	6.1
February	2.8	.1	.1	.10	5.6
March	4,355.2	650	.1	140	8,640
April	1,062	100	10	35.4	2,110
May	244.0	11	3.7	7.87	484
June	152.5	15	2.7	5.08	302
July	1,486.5	277	.8	48.0	2,950
August	8.9	1.1	.1	.29	18
September	171.5	21	.2	5.72	340
Water year 1945-46	7,616.4	650	.1	20.9	15,110

FOREST RIVER NEAR FORDVILLE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	87.7	3.2	2.2	2.83	174
November	255.8	25	2.4	8.53	507
December	201.4	8.5	2.4	6.50	399
January	114.9	5.0	2.2	3.71	228
February	137.7	5.6	4.3	4.92	273
March	2,561.6	224	5.0	82.6	5,080
April	609	63	12	20.3	1,210
May	355	15	10	11.5	704
June	263.8	16	4.5	8.79	523
July	121.1	4.4	3.0	3.91	240
August	50.7	2.9	1.0	1.64	101
September	84.5	5.0	1.0	2.82	168
Water year 1944-45	4,843.2	224	1.0	13.3	9,607

FOREST RIVER AT FORDVILLE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	91.7	3.8	2.3	2.96	182
November	111.4	4.0	3.5	3.71	221
December	117.8	4.2	3.5	3.80	234
January	142.4	4.8	4.0	4.59	282
February	118.2	4.8	3.8	4.22	234
March	3,772.4	900	4.5	122	7,480
April	599.9	49	8.9	20.0	1,190
May	223.4	9.8	5.2	7.21	443
June	210.7	19	4.7	7.02	418
July	123.0	8.9	2.2	3.97	244
August	71.3	3.6	2.0	2.30	141
September	129.1	14	2.4	4.30	256
Water year 1945-46	5,711.3	900	2.0	15.6	11,320

FOREST RIVER AT MINTO, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	75.5	3.0	2.3	2.44	150
November	440.0	26	2.3	14.7	873
December	347.2	18	3.7	11.2	689
January	79.2	4.5	1.2	2.55	157
February	45.8	2.3	1.2	1.64	91
March	2,776.2	239	0.8	89.6	5,510
April	1,418	127	24	47.3	2,810
May	622	24	18	20.1	1,230
June	455.6	19	9.3	15.2	904
July	173.2	9.3	2.3	5.59	344
August	89.8	4.5	.5	2.90	178
September	29.6	3.0	0	.99	59
Water year 1944-45	6,552.6	239	0	18.0	12,995

FOREST RIVER AT MINTO, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	65.6	4.6	0.8	2.12	130
November	82.7	3.8	2.1	2.76	164
December	32.7	2.0	.6	1.05	65
January	15.5	.5	.5	.50	31
February	5.5	.5	0	.20	11
March	4,802.0	1,000	0	155	9,520
April	1,267	109	21	42.2	2,510
May	328.6	18	7.0	10.6	652
June	267.0	13	7.0	8.90	530
July	166.1	13	0	5.36	329
August	0	0	0	0	0
September	89.3	12	0	2.98	177
Water year 1945-46	7,122.0	1,000	0	19.5	14,120

SOUTH BRANCH PARK RIVER NEAR PARK RIVER, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	11.1	0.6	0.2	.36	22
November	111	8.0	1	3.7	220
December	86.1	4.1	1	2.78	171
January	8.5	0.5	0.1	2.74	17
February	5.6	0.2	0.2	0.20	11
March	4,772.8	581	0.2	154	9,470
April	703	56	11	23.4	1,390
May	354.6	18	6.1	11.4	703
June	202.5	17	1.1	6.75	402
July	74.8	6.1	0.1	2.41	148
August	7.0	0.4	0.1	2.25	14
September	4.9	0.2	0.1	1.63	9.7
Water year 1944-45	6,341.9	581	0.1	17.4	12,577.7

SOUTH BRANCH OF PARK RIVER NEAR PARK RIVER, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	5.6	.2	.1	.18	11
November	4.5	.2	.1	.15	8.9
December	3.1	.1	.1	.10	6.1
January	3.1	.1	.1	.10	6.1
February	2.8	.1	.1	.10	5.6
March	2,854.0	400	.1	92.0	5,660
April	531.2	39	4.8	17.7	1,050
May	113.2	8.6	2.3	3.65	225
June	82.0	25	.1	2.73	163
July	3.5	.5	0	.11	6.9
August	3.1	.1	.1	.10	6.1
September	15.9	2.3	.1	.53	32
Water year 1945-46	3,622.0	400	0	9.92	7,180

PARK RIVER AT GRAFTON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	25.9	4.0	0.4	0.84	51
November	436.5	35	0.5	14.6	866
December	216.6	29	0.4	6.99	430
January	8.2	.3	0.2	0.26	16
February	6.4	.3	0.2	0.23	13
March	12,709.8	1,140	0.1	410	25,210
April	4,029	536	52	134	7,990
May	1,758	75	44	56.7	3,490
June	945	54	21	31.5	1,870
July	227.4	20	1.6	7.34	451
August	26.2	.2	.1	0.85	52
September	18.3	1.6	.1	0.61	36
Water year 1944-45	20,407.3	1,140	.1	55.9	40,475

PARK RIVER AT GRAFTON, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	5.0	.3	.1	.16	9.9
November	6.3	.4	.2	.21	12
December	4.3	.3	.1	.14	8.5
January	3.1	.1	.1	.10	6.1
February	3.5	.2	.1	.12	6.9
March	7,336.5	1,150	.1	237	14,550
April	2,055	147	28	68.5	4,080
May	295.8	19	4.5	9.54	587
June	147.9	9.4	3.0	4.93	293
July	39.3	6.3	0	1.27	78
August	4.0	1.1	0	.13	7.9
September	11.2	2.2	0	.37	22
Water year 1945-46	9,911.9	1,150	0	27.2	19,660

PEMBINA RIVER NEAR MANITOU, MANITOBA, CANADA
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	7,414	1,480	472	927	14,710
April	25,535	980	700	851	50,650
May	16,256	710	383	524	32,240
June	8,259	366	192	275	16,380
July	6,156	480	136	199	12,210
August	2,961	131	70	95.5	5,870
September	1,913	81	54	63.8	3,790
Water year 1944-45	68,494	1,480	54	------	135,800

PEMBINA RIVER NEAR MANITOU, MANITOBA, CANADA
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	1,308.7	54	35.6	42.2	2,600
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March 23-31	5,696	863	559	633	11,300
April	13,644	616	293	455	27,060
May	5,595	279	87	181	11,100
June	1,837.0	87	36.8	61	3,640
July	1,102.4	50	22.5	35.6	2,190
August	540.0	21.0	14.4	17.4	1,070
September	328.4	13.0	6.8	10.9	652

PEMBINA RIVER NEAR MANITOU, MANITOBA, CANADA
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	429.5	17.5	10.0	13.9	852
November 1-15	189.5	17.0	10.5	12.6	376
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March 30-31	125	75	50	63	248
April	9,742	516	100	325	19,320
May	6,484	283	137	209	12,860
June	2,543	134	54	85	5,040
July	1,118.5	77	26.0	37.0	2,220
August	1,587.1	83	25.5	51	3,150
September	1,363.6	49.8	40.8	45.5	2,700

PEMBINA RIVER NEAR WALHALLA, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	5,612	242	135	181	11,130
November	6,389	938	80	213	12,670
December	2,768	135	50	89.3	5,490
January	1,299	50	36	41.9	2,580
February	1,161	47	34	41.5	2,300
March	24,915	2,780	32	804	49,420
April	30,182	1,560	876	1,006	59,870
May	21,441	899	531	692	42,530
June	11,188	527	24.8	373	22,190
July	6,963	375	175	225	13,810
August	3,663	166	80	118	7,270
September	2,401	97	70	80	4,760
Water year 1944-45	117,982	2,780	32	323	234,020

PEMBINA RIVER NEAR WALHALLA, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	1,729	69	40	55.8	3,430
November	907	47	24	30.2	1,800
December	504	26	10	16.3	1,000
January	293.2	10	7.9	9.46	582
February	223.9	8.8	7.5	8.00	444
March	19,241	1,910	7.9	621	38.160
April	18,780	911	382	626	37,250
May	7,521	371	135	243	14,920
June	2,543	123	56	84.8	5,040
July	1,521	86	31	49.1	3,020
August	644	29	15	20.8	1,280
September	448.2	21	9.4	14.9	889
Water year 1945-46	54,355.3	1,910	7.5	149	107,800

PEMBINA RIVER NEAR WALHALLA, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	668	29	16	21.5	1,320
November	603	28	14	20.1	1,200
December	289	14	4	9.3	573
January	151	12	2	4.9	300
February	77.9	4	1.3	2.78	155
March	373.8	100	.4	12.1	741
April	16,960	1,240	200	565	33,640
May	7,996	371	188	258	15,860
June	5,112	266	144	170	10,140
July	2,105	121	38	67.9	4,180
August	3,975	958	36	128	7,880
September	1,671	69	48	55.7	3,310
Water year 1946-47	39,981.7	1,240	.4	110	79,300

PEMBINA RIVER AT NECHE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	6,298	274	153	203	12,490
November	7,012	680	77	234	13,910
December	3,256	181	54	105	6,460
January	1,329	53	36	42.9	2,640
February	1,387	56	42	49.5	2,750
March	22,966	2,400	38	741	45,550
April	32,391	1,730	918	1,080	64,250
May	23,542	933	607	759	46,690
June	13,179	597	305	439	26,140
July	7,968	352	213	257	15,800
August	4,413	204	101	142	8,750
September	2,892	111	79	96.4	5,740
Water year 1944-45	126,633	2,400	36	347	251,170

PEMBINA RIVER AT NECHE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	2,071	79	54	66.8	4,110
November	1,069	53	23	35.6	2,120
December	673	34	11	21.7	1,330
January	278.5	11	8.1	8.98	552
February	250.8	9.3	8.1	8.96	497
March	17,619.5	2,070	8.1	568	34,950
April	20,221	917	450	674	40,110
May	8,996	430	172	290	17,840
June	3,402	165	77	113	6,750
July	2,094	96	44	67.5	4,150
August	992	42	23	32	1,970
September	609.3	28	9.3	20.3	1,210
Water year 1945-46	58,276.1	2,070	8.1	160	115,600

PEMBINA RIVER AT NECHE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	915	39	27	29.5	1,810
November	633	42	12	22.8	1,350
December	229.0	11	3.0	7.39	454
January	54.7	3.0	.8	1.76	108
February	33.5	1.5	.6	1.20	66
March	31.8	2.6	.6	1.03	63
April	18,270.4	1,290	3.4	609	36,240
May	9,050	387	213	292	17,950
June	5,994	278	147	200	11,890
July	2,726	159	53	87.9	5,410
August	3,793	566	46	122	7,520
September	1,950	87	56	65.0	3,870
Water year 1946-47	43,730.4	1,290	.6	120	86,730

PEMBINA RIVER AT NECHE, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1947-1948					
October	1,658	66	48	53.5	3,290
November	844	48	18	28.1	1,670
December	478	20	12	15.4	948
January	436	16	10	14.1	865
February	159	9	5	5.5	315
March	156	6	5	5.0	309
April	27,907	3,600	6	930	55,350
May	27,542	1,310	654	888	54,630
June	12,387	628	274	413	24,570
July	9,671	510	213	312	19,180
August	6,106	255	165	197	12,110
September	3,517	162	84	117	6,980
Water year 1947-48	90,861	3,600	5	248	180,200

TONGUE RIVER AT CAVALIER, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	112.8	4.8	3.2	3.64	224
November	1,358.9	321	3.4	45.3	2,700
December	310.2	18	4.4	10.0	615
January	113.1	4.4	3.1	3.65	224
February	79.3	3.4	2.4	2.83	157
March	5,717.3	855	2.2	184	11,340
April	1,808	130	38	60.3	3,590
May	1,318	114	27	42.5	2,610
June	899	130	13	30.0	1,780
July	530.5	114	5.7	17.1	1,050
August	106.9	6.2	1.8	3.45	212
September	127.1	8.1	1.8	4.24	252
Water year 1944-45	12,481.1	855	1.8	34.2	24,754

TONGUE RIVER AT CAVALIER, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	107.1	5.1	2.3	3.45	212
November	115.5	5.3	3.0	3.85	229
December	75.8	4.1	1.0	2.45	150
January	48.4	1.8	1.1	1.56	96
February	36.3	1.4	1.2	1.30	72
March	2,826.3	363	1.2	91.2	5,610
April	981	77	11	32.7	1,950
May	370.0	18	9.2	11.9	734
June	184.4	11	3.4	6.15	366
July	86.7	9.4	.7	2.80	172
August	13.9	1.1	.2	.45	28
September	72.1	7.9	.1	2.40	143
Water year 1945-46	4,917.5	363	.1	13.5	9,760

TONGUE RIVER AT CAVALIER, N. DAK.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	118.2	7.0	2.0	3.81	234
November	83.7	4.5	1.1	2.79	166
December	28.9	2.5	0	.93	57
January	1.0	.1	0	.03	2.0
February	0	0	0	0	0
March	15	10	0	.5	30
April	2,465	300	24	82.2	4,890
May	419.3	24	7.9	13.5	832
June	1,077.6	128	7.9	35.9	2,140
July	282.4	24	3.9	9.11	560
August	139.1	7.9	1.5	4.49	276
September	61.8	6.1	.4	2.06	123
Water year 1946-47	4,692.0	300	0	12.9	9,310

SOURIS RIVER NEAR SHERWOOD, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	442.6	18	8.5	14.3	878
November	336.5	26	4.6	11.2	667
December	130.2	5.8	1.6	4.2	258
January	50.2	2	1.0	1.62	100
February	40.3	1.7	1.2	1.44	79.9
March	873.6	105	1.1	28.2	1,730
April	963	68	20	32.1	1,910
May	482	20	13	15.5	956
June	518	27	13	17.3	1,030
July	928	56	15	29.9	1,840
August	313.4	17	2.7	10.1	622.
September	66	4.4	1.0	2.2	131
Water year 1944-45	5,143.8	105	1.0	14.1	10,201.9

SOURIS RIVER NEAR SHERWOOD, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	117.0	4.7	2.4	3.77	232
November	118.5	6.0	2.4	3.95	235
December	25.6	2.4	0	.83	51
January	0	0	0	0	0
February	.5	.1	0	.02	1.0
March	17,162	1,980	0	554	34,040
April	8,599	863	55	287	17,060
May	1,076	54	27	34.7	2,130
June	700	36	11	23.3	1,390
July	439.2	23	8.8	14.2	871
August	185.6	15	3.2	5.99	368
September	52.3	4.4	.8	1.74	104
Water year 1945-46	28,475.7	1,980	0	78.0	56,480

SOURIS RIVER NEAR SHERWOOD, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	95.6	5.8	1.9	3.08	190
November	58.5	2.6	1.6	1.95	116
December	34.9	1.6	.5	1.13	69
January	22.5	.8	.7	.73	45
February	13.0	.6	.1	.46	26
March	1,692.4	900	.1	54.6	3,360
April	48,080	2,250	840	1,603	95,370
May	11,310	721	168	365	22,430
June	6,544	682	58	218	12,980
July	4,417	473	38	142	8,760
August	919	42	21	29.6	1,820
September	713.6	46	6.9	23.8	1,420
Water year 1946-47	73,900.5	2,250	.1	202	146,600

SOURIS RIVER NEAR SHERWOOD, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1947-1948					
October	410.2	29	4.5	13.2	814
November	287.3	14	6.2	9.58	570
December	329	13	8	10.6	653
January	247	12	4	7.97	490
February	174	6	6	6.0	345
March	161	6	4	5.2	319
April	41,111	7,380	5	1,370	81,540
May	73,509	7,070	262	2,371	145,800
June	5,040	248	118	168	10,000
July	2,870	140	74	92.6	5,690
August	1,500	149	23	48.4	2,980
September	375.4	21	8.4	12.5	745
Water year 1947-48	126,013.9	7,380	4	344	249,900

SOURIS RIVER NEAR FOXHOLM, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	3,121	107	87	101	6,190
November	3,213	137	60	107	6,370
December	2,644	89	84	85.3	5,240
January	2,622	87	84	84.6	5,200
February	2,097	87	36	74.9	4,160
March	1,377	77	17	44.4	2,730
April	567.1	31	5.7	18.9	1,120
May	409.8	39	1.7	13.2	813
June	138.2	12	0.2	4.6	274
July	15.2	1.4	0.1	0.49	30
August	3.3	1.7	0	0.11	6.5
September	21.0	2	0.3	0.7	42
Water year 1944-45	16,228.6	137	0	44.5	32,175.5

SOURIS RIVER NEAR FOXHOLM, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	12.1	1.1	0.1	0.39	24
November	57.6	32	.3	1.92	114
December	8.6	.4	.2	.28	17
January	13.8	.7	.3	.45	27
February	10.0	.4	.3	.36	20
March	12.0	1.1	.2	.39	24
April	4,211.1	250	.2	140	8,350
May	1,365.9	151	3.4	44.1	2,710
June	73.4	3.4	1.7	2.45	146
July	536.3	58	0	17.3	1,060
August	3.2	.5	0	.10	6.3
September	1,384.2	68	0	46.1	2,750
Water year 1945-46	7,688.2	250	0	21.1	15,250

SOURIS RIVER NEAR FOXHOLM, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	53.7	6.2	.3	1.73	107
November	2,718	112	15	90.6	5,390
December	2,289.6	107	.4	73.9	4,540
January	8.9	.5	.2	.29	18
February	6.4	.3	.2	.23	13
March	5,109.4	950	.2	.65	10,130
April	23,926	1,310	160	798	47,460
May	13,096	1,140	120	422	25,980
June	3,346	157	52	112	6,640
July	10,054	404	187	324	19,940
August	8,122.9	359	9.9	262	16,110
September	1,530.5	110	4.4	51.0	3,040
Water year 1946-47	70,261.4	1,310	.2	192	139,400

SOURIS RIVER NEAR FOXHOLM, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1947-1948					
October	136.0	13	1.2	4.39	270
November	200.3	9.9	1.2	6.68	397
December	310.8	12	8.2	10.0	616
January	305.6	10	9.0	9.86	606
February	290	10	10	10.0	575
March	4,400	380	10	142	8,730
April	22,032.9	2,090	3.9	734	43,700
May	68,420	2,790	1,560	2,207	135,700
June	13,536.9	1,190	5.2	451	26,850
July	3,338	195	13	108	6,620
August	1,113	106	1.2	35.9	2,210
September	2,946	122	91	98.2	5,840
Water year 1947-48	117,029.5	2,790	1.2	320	232,100

SOURIS RIVER ABOVE MINOT, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	3,501	119	105	113	6,940
November	3,582	142	89	119	7,100
December	2,622	100	82	84.6	5,200
January	2,653	93	84	85.6	5,260
February	2,238	98	38	79.9	4,440
March	2,960	425	36	95.5	5,870
April	921	53	15	30.7	1,830
May	578.5	34	8.1	18.7	1,150
June	416	41	2	13.9	825
July	104.8	8.1	0.8	3.38	208
August	26.1	3.2	0	0.84	52
September	0	0	0	0	0
Water year 1944-45	19,602.4	425	0	53.7	38,875

SOURIS RIVER ABOVE MINOT, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	13.5	1.4	0	.44	27
November	82.3	14	.2	2.74	163
December	41.5	2.0	1.0	1.34	82
January	36.8	1.4	.8	1.19	73
February	15.1	.8	.4	.54	30
March	899.6	124	.4	29	1,780
April	4,403	243	21	147	8,730
May	1,520.7	148	2.7	49.1	3,020
June	57.2	3.6	1.3	1.91	113
July	467.1	57	0	15.1	926
August	1.1	.4	0	.04	2.2
September	1,320.6	69	0	44.0	2,620
Water year 1945-46	8,858.5	243	0	24.3	17,570

SOURIS RIVER ABOVE MINOT, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	110.5	8.7	1.5	3.56	219
November	2,516.4	112	2.3	83.9	4,990
December	2,347.2	105	3.4	75.7	4,660
January	44.5	3.0	1.0	1.44	88
February	17.0	.9	.4	.61	34
March	6,512.5	1,050	.4	210	12,920
April	27,402	1,350	288	913	54,350
May	15,096	1,230	129	487	29,940
June	4,486	332	96	150	8,900
July	9,954	400	118	321	19,740
August	8,176	343	29	264	16,220
September	1,905	115	11	63.5	3,780
Water year 1946-47	78,567.1	1,350	.4	215	155,800

SOURIS RIVER ABOVE MINOT, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1947-1948					
October	288.9	26	4.6	9.32	573
November	309.9	12	8.7	10.3	615
December	371	12	11	12.0	736
January	344	12	10	11.1	682
February	305	11	10	10.5	605
March	4,057	340	11	131	8,050
April	24,290	1,650	380	810	48,180
May	67,080	2,680	1,760	2,164	133,100
June	15,478	1,660	24	516	30,700
July	4,208	203	53	136	8,350
August	2,386	111	39	77.0	4,730
September	3,299	130	97	110	6,540
Water year 1947-48	122,416.8	2,680	4.6	334	242,900

SOURIS RIVER AT VERENDRYE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	3,615	162	68	117	7,170
November	3,881	157	101	129	7,700
December	2,632	100	79	84.9	5,220
January	2,608	88	79	84.1	5,170
February	2,363	90	81	84	4,690
March	8,274	640	52	267	16,410
April	2,130	171	35	71	4,220
May	1,121	68	24	36.2	2,220
June	967	57	14	32.2	1,920
July	538	28	12	17.4	1,070
August	408.5	23	8	13.2	810
September	222.5	10	6	7.42	441
Water year 1944-45	28,760	640	6	78.8	57,041

SOURIS RIVER AT VERENDRYE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	198.0	9.3	4.2	6.39	393
November	234.0	9.3	6.8	7.80	464
December	213.6	8.2	5.3	6.89	424
January	168.8	6.0	5.0	5.45	335
February	144.0	5.3	4.9	5.14	286
March	4,221.2	376	5.3	136	8,370
April	4,797	267	62	160	9,510
May	2,306	154	18	74.4	4,570
June	390.0	21	8.2	13.0	774
July	469.4	39	5.3	15.1	931
August	130.6	7.3	2.7	4.21	259
September	1,022.9	65	4.5	34.1	2,030
Water year 1945-46	14,295.5	376	2.7	39.2	28,350

SOURIS RIVER AT VERENDRYE, N. D.
(Addition to Supplement "B" of the Fourth Biennial Report.)
Stream-Flow Information

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	401.3	37	7.1	12.9	796
November	1,999.5	105	8.8	66.6	3,970
December	2,757	110	28	88.9	5,470
January	270.0	24	3.0	8.71	536
February	80.6	5.0	2.0	2.88	160
March	4,545.0	750	1.0	147	9,010
April	26,651	1,300	498	888	52,860
May	19,460	1,220	179	628	38,600
June	5,724	360	136	191	11,350
July	9,592	431	115	309	19,030
August	9,477	388	38	306	18,800
September	2,090	156	31	69.7	4,150
Water year 1946-47	83,047.4	1,300	1.0	228	164,700

SOURIS RIVER AT VERENDRYE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Fe
1947-1948					
October	625	32	15	20.2	1,240
November	451	19	12	15.0	895
December	470	17	14	15.2	932
January	456	16	13	14.7	904
February	348	12	12	12.0	690
March	2,396	230	12	77.3	4,750
April	28,560	1,980	240	952	56,650
May	63,520	2,290	1,290	2,049	126,000
June	24,833	1,970	170	828	49,260
July	6,571	291	120	212	13,030
August	3,121	131	77	101	6,190
September	3,606	147	98	120	7,150
Water year 1947-48	134,957	2,290	12	369	267,700

SOURIS RIVER NEAR BANTRY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	3,501	135	92	113	6,940
November	3,838	150	115	128	7,610
December	3,152	130	77	102	6,250
January	2,561	91	75	82.6	5,080
February	2,539	102	84	90.7	5,040
March	9,015	766	75	291	17,880
April	5,586	381	63	186	11,080
May	2,042	72	62	65.9	4,050
June	2,135	169	40	71.2	4,230
July	1,208	54	28	39	2,400
August	856	40	13	27.6	1,700
September	276.3	17	6.9	9.21	548
Water year 1944-45	36,709.3	766	6.9	101	72,808

SOURIS RIVER NEAR BANTRY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	457	26	10	14.7	906
November	557	22	18	18.6	1,100
December	486	19	11	15.7	964
January	384	13	11	12.4	762
February	290.3	11	9.2	10.4	576
March	2,857	594	10	92.2	5,670
April	6,411	606	84	214	12,720
May	3,717	218	74	120	7,370
June	1,249	92	21	41.6	2,480
July	773	41	15	24.9	1,530
August	201.0	14	3.9	6.48	399
September	402.1	49	5.1	13.4	798
Water year 1945-46	17,784.4	606	3.9	48.7	35,280

SOURIS RIVER NEAR BANTRY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	1,218	72	18	39.3	2,420
November	1,581	89	19	52.7	3,140
December	2,964	106	80	95.6	5,880
January	657.0	70	8.0	21.2	1,300
February	152.0	8.0	2.5	5.43	301
March	1,008.0	420	1.0	32.5	2,000
April	25,175	1,320	500	839	49,930
May	24,902	1,230	334	803	49,390
June	7,507	389	195	250	14,890
July	10,919	427	198	352	21,660
August	10,477	389	276	338	20,780
September	2,432	213	62	81.1	4,820
Water year 1946-47	88,992.0	1,320	1.0	244	176,500

SOURIS RIVER NEAR BANTRY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1947-1948					
October	1,353	87	23	43.6	2,680
November	700	32	20	23.3	1,390
December	607	21	18	19.6	1,200
January	522	18	14	16.8	1,040
February	344	13	11	11.9	682
March	1,566	210	12	50.5	3,110
April	22,965	1,700	220	766	45,550
May	53,970	1,990	1,470	1,741	107,000
June	39,590	1,990	478	1,320	78,530
July	10,969	449	252	354	21,760
August	4,785	275	114	154	9,490
September	3,427	133	98	114	6,800
Water year 1947-48	140,798	1,990	11	385	279,200

SOURIS RIVER NEAR WESTHOPE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	2,920	346	19	94.2	5,790
November	2,015.7	157	0.5	67.2	4,000
December	4,357	149	130	141	8,640
January	3,638	146	68	117	7,220
February	2,015	79	68	72	4,000
March	4,874	1,040	1	157	9,670
April	22,631	1,020	213	754	44,890
May	5,208.3	650	0.2	168	10,330
June	784.9	47	0.3	26.2	1,560
July	591.4	41	2.5	19.1	1,170
August	2,757.5	196	3.9	89.0	5,470
September	545.9	37	1.9	18.2	1,080
Water year 1944-45	52,338.7	1,040	0.2	143	103,820

SOURIS RIVER NEAR WESTHOPE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	582.6	54	9.6	18.8	1,160
November	20.1	12	0	.67	40
December	0	0	0	0	0
January	0	0	0	0	0
February	0	0	0	0	0
March	61.8	25	0	1.99	123
April	9,630	600	30	321	19,100
May	752	120	13	24.3	1,490
June	576.9	26	7.8	19.2	1,140
July	485.5	24	1.1	15.7	963
August	640.8	29	1.7	20.7	1,270
September	1,910	122	18	63.7	3,790
Water year 1945-46	14,659.7	600	0	40.2	29,080

SOURIS RIVER NEAR WESTHOPE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	373.8	28	3.1	12.0	741
November	15.6	9.3	0	.52	31
December	0	0	0	0	0
January	8.6	1.0	0	.28	17
February	28.8	1.1	1.0	1.03	57
March	31.6	1.3	1.0	1.02	63
April	31,258	1,800	3.0	1,042	62,000
May	20,960	940	40	676	41,570
June	5,849	438	97	195	11,600
July	11,861	450	140	383	23,530
August	8,881	320	191	286	17,620
September	2,199	275	11	73.3	4,360
Water year 1946-47	81,466.4	1,800	0	223	161,600

SOURIS RIVER NEAR WESTHOPE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1947-1948					
October	331.7	17	6.8	10.7	658
November	303.4	42	0	10.1	602
December	24.9	1.6	0	.80	49
January	18.4	1.6	0	.59	36
February	6.4	.3	.1	.22	13
March	14.5	.5	.4	.47	29
April	26,701	2,900	1	890	52,960
May	67,970	2,800	1,750	2,193	134,800
June	50,900	1,900	1,100	1,697	101,000
July	10,536	950	21	340	20,900
August	7,669	433	47	247	15,210
September	1,284	47	36	42.8	2,550
Water year 1947-48	165,759.3	2,900	0	453	328,800

LONG CREEK NEAR CROSBY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1942-1943					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	------	------	------	------	------
April 1-10, 1943	15,925	2,960	463	1,590	31,590
May	------	------	------	------	------
June	------	------	------	------	------
July	------	------	------	------	------
August	------	------	------	------	------
September	------	------	------	------	------

LONG CREEK NEAR CROSBY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1943-1944					
October	------	------	------	------	------
November	------	------	------	------	------
December	------	------	------	------	------
January	------	------	------	------	------
February	------	------	------	------	------
March	------	------	------	------	------
April 7-16, 1944	2.6	0.7	0	0.26	5.2
May	------	------	------	------	------
June 4-30	491.0	58	0	18.2	974
July 27-31	10.8	2.6	1.2	2.16	21
August	131.1	9.4	0	4.23	260
September	0	0	0	0	0

LONG CREEK NEAR CROSBY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October 1944	0	0	0	0	0
November	0	0	0	0	0
December	0	0	0	0	0
January 1945	0	0	0	0	0
February	0	0	0	0	0
March	67.2	5.4	0	2.17	133
April	51.7	7.7	0	1.72	102
May	.8	.6	0	.03	1.6
June	0	0	0	0	0
July	0	0	0	0	0
August	11.0	3.8	0	.35	22
September	0	0	0	0	0
Water year 1944-45	130.7	7.7	0	.36	259

LONG CREEK NEAR CROSBY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	0	0	0	0	0
November	0	0	0	0	0
December	0	0	0	0	0
January	0	0	0	0	0
February	0	0	0	0	0
March	3,582.7	678	0	116	7,110
April	589.2	67	3.5	19.6	1,170
May	31.6	5.2	0	1.02	63
June	.9	.3	0	.03	1.8
July	344.2	150	0	11.1	683
August	0	0	0	0	0
September	0	0	0	0	0
Water year 1945-46	4,548.6	678	0	12.5	9,030

LONG CREEK NEAR CROSBY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	0	0	0	0	0
November	0	0	0	0	0
December	0	0	0	0	0
January	0	0	0	0	0
February	0	0	0	0	0
March	3,340	600	0	108	6,620
April	11,319	936	63	377	22,450
May	579.6	61	7.7	18.7	1,150
June	455.1	83	3.6	15.2	903
July	193.7	34	.4	6.25	384
August	264.6	31	.1	8.54	525
September	240.6	20	2.5	8.02	477
Water year 1946-47	16,392.6	936	0	44.9	32,510

LONG CREEK NEAR CROSBY, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1947-1948					
October	162.9	8.3	0.6	5.25	323
November	90.3	5.4	1.9	3.01	179
December	31	-------	-------	1.0	61
January	15.5	-------	-------	.5	31
February	0	0	0	0	0
March	0	0	0	0	0
April	35,215	6,010	0	1,174	69,850
May	3,716	518	12	120	7,370
June	189.0	13	1.5	6.30	375
July	262.0	110	.6	8.45	520
August	3.5	.6	0	.11	6.9
September	0	0	0	0	0
Water year 1947-48	39,685.2	6,010	0	108	78,720

DES LACS RIVER AT FOXHOLM, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	17.4	1.0	0.2	0.56	35
November	30.4	2.0	.5	1.01	60
December	3.8	.5	0	.12	7.5
January	0	0	0	0	0
February	0	0	0	0	0
March	795.0	110	0	25.6	1,580
April	285.2	25	3.0	9.51	566
May	72.8	3.3	1.5	2.35	144
June	20.4	2.0	.2	.68	40
July	29.9	2.8	.1	.96	59
August	3.7	.4	.1	.12	7.3
September	.3	.1	0	.01	.6
Water year 1945-46	1,258.9	110	0	3.45	2,500

DES LACS RIVER AT FOXHOLM, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
October	14.6	0.9	0	0.47	29
November	18.0	.9	.3	.60	36
December	4.5	.5	0	.15	8.9
January	0	0	0	0	0
February	0	0	0	0	0
March	2,360	600	0	76.1	4,680
April	2,183.0	322	9.0	72.8	4,330
May	180.2	9.2	2.7	5.81	357
June	889.6	290	2.3	29.7	1,760
July	152.0	21	.5	4.90	301
August	46.5	3.7	.4	1.50	92
September	49.6	7.5	.3	1.65	98
1946-1947					
Water year 1946-47	5,898.0	600	0	16.2	11,690

DES LACS RIVER AT FOXHOLM, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1947-1948					
October	32.7	1.1	1.0	1.05	65
November	30.3	1.2	.8	1.01	60
December	19.7	1.0	.3	.64	39
January	5.6	.3	0	.18	11
February	0	0	0	0	0
March	3.1	2.0	0	.10	6.1
April	5,390.0	498	.1	180	10,690
May	1,806.8	219	9.1	58.3	3,580
June	251.1	32	2.0	8.37	498
July	1,072	63	23	34.6	2,130
August	1,116	86	24	36.0	2,210
September	509.7	23	6.8	17.0	1,010
Water year 1947-48	10,237.0	498	0	28.0	20,300

WINTERING RIVER NEAR KARLSRUHE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1944-1945					
October	128	5.2	3.2	4.13	254
November	216.7	14	2.9	7.22	430
December	79.2	4	0.6	2.55	157
January	10.3	0.5	0.2	0.33	20
February	2.8	0.1	0.1	0.1	5.6
March	2,481.5	200	0.1	80	4,920
April	1,456	114	14	48.5	2,890
May	321.1	15	8.4	10.4	637
June	210.9	11	3.2	7.03	418
July	140.1	7	2.7	4.52	278
August	88.6	6.2	0.9	2.86	176
September	78.7	5.0	0.9	2.62	156
Water year 1944-45	5,213.9	200	0.1	14.3	10,341.6

WINTERING RIVER NEAR KARLSRUHE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1945-1946					
October	105.8	4.6	2.9	3.41	210
November	77.1	4.3	1.9	2.57	153
December	62.6	2.9	1.5	2.02	124
January	40.9	1.7	.6	1.32	81
February	4.2	.5	.1	.15	8.3
March	656.4	67	.1	21.1	1,300
April	801.1	62	7.9	26.7	1,590
May	166.3	7.7	3.2	5.36	330
June	91.8	5.0	1.9	3.06	182
July	49.3	4.4	.6	1.59	98
August	32.5	2.9	.5	1.05	64
September	52.6	2.9	1.0	1.75	104
Water year 1945-46	2,140.6	67	.1	5.86	4,240

WINTERING RIVER NEAR KARLSRUHE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1946-1947					
October	114.4	6.1	2.1	3.69	227
November	79.8	6.1	1.0	2.66	158
December	27.3	2.1	.1	.88	54
January	3.1	.1	.1	.10	6.1
February	.5	.1	0	.02	1.0
March	371	70	0	12.0	736
April	2,009	156	17	67.0	3,980
May	270.2	15	4.9	8.72	536
June	248.3	19	3.8	8.28	492
July	1,097.5	116	7.4	35.4	2,180
August	559.2	53	4.3	18.0	1,110
September	137.8	6.0	3.5	4.59	273
Water year 1946-47	4,918.1	156	0	13.5	9,750

WINTERING RIVER NEAR KARLSRUHE, N. D.
Stream-Flow Information
(Addition to Supplement "B" of the Fourth Biennial Report.)

Month	Second Foot Days	Maximum	Minimum	Mean	Run-off in Acre-Feet
1947-1948					
October	106.7	3.8	3.2	3.44	212
November	87.9	4.2	2.5	2.93	174
December	65.5	2.5	1.8	2.11	130
January	42.9	1.7	.8	1.38	85
February	4.8	.7	0	.17	9.5
March	16.1	2	0	.52	32
April	3,218	377	2	107	6,380
May	1,486	131	11	47.9	2,950
June	230.8	13	4.9	7.69	458
July	320.0	19	2.6	10.3	635
August	404.6	22	5.2	13.1	803
September	91.3	4.9	2.4	3.04	181
Water year 1947-48	6,074.6	331	0	16.6	12,050

DEVILS LAKE NEAR DEVILS LAKE, N. D.

Month 1944-45	Elevation in feet
October 14th	1,403.40
November 18th	1,403.50
December	----------
January	----------
February	----------
March 5th	1,404.09
April 25th	1,404.31
May 10th	1,404.34
June 11th	1,404.36
July 12th	1,404.06
August 18th	1,403.90
September 25th	1,403.79

DEVILS LAKE NEAR DEVILS LAKE, N. D.

Month 1945-1946	Elevation in feet
October 16th	1,403.69
November 30th	1,403.67
December 11th	1,403.69
January	
February	
March	
April 17th	1,404.75
May 10th	1,404.70
June 21st	1,404.32
July 11th	1,404.27
August 11th	1,403.84
September 6th	1,403.47

DEVILS LAKE NEAR DEVILS LAKE, N. D.

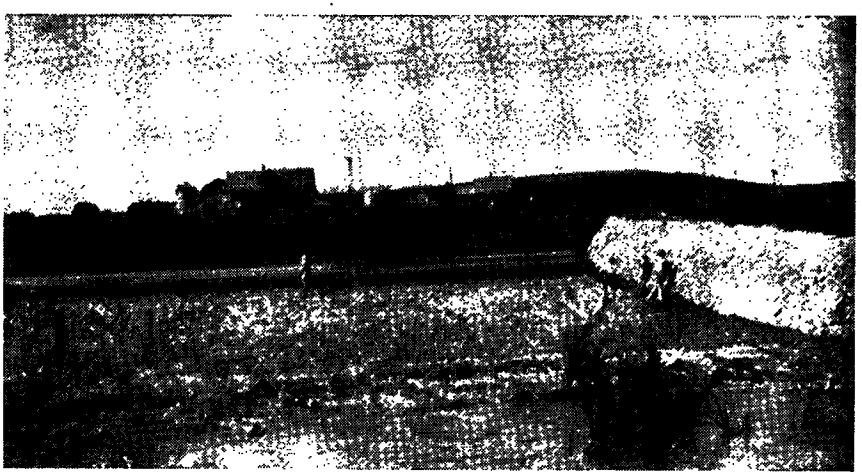
Month 1946-1947	Elevation in feet
October 21st	1,403.57
November 30th	1,403.59
December 10th	1,403.45
January 7th	1,403.48
February	
March	
April	
May 26th	1,403.55
June 25th	1,403.43
July 16th	1,403.28
August 13th	1,403.25
September	1,403.25

LAKE DARLING NEAR FOXHOLM, N. D.

Month	Maximum		Minimum	
	Gage-height	Storage in Acre-feet	Gage-height	Storage in Acre-feet
1944-45				
October	16.4	70,400	15.3	61,400
November	15.3	61,400	14.9	58,300
December	14.9	58,300	14.4	54,800
January	14.4	54,800	13.5	49,000
February	13.5	49,000	13.0	46,000
March	13.0	46,000	12.7	44,200
April	13.0	46,000	13.0	46,000
May	13.0	46,000	12.6	43,600
June	12.6	43,600	12.5	43,000
July	12.5	43,000	12.5	43,000
August	12.1	40,600	11.8	39,000
September	12.0	40,000	11.0	35,000
1945-46				
October	12.4	42,400	11.7	38,500
November	12.0	40,000	12.0	40,000
December	12.0	40,000	12.0	40,000
January	12.0	40,000	12.0	40,000
February	12.0	40,000	12.0	40,000
March	15.0	59,000	12.0	40,000
April	17.4	78,900	14.9	58,300
May	17.0	75,500	16.7	72,950
June	16.7	72,950	16.6	72,100
July	16.6	72,100	16.1	67,850
August	16.1	67,850	15.9	66,200
September	15.9	66,200	15.0	59,000

LAKE DARLING NEAR FOXHOLM, N. D.

	Gage	Maximum	Gage	Minimum
1946-1947				
October	15.4	60,600	15.10	59,000
November	15.3	60,200	14.7	56,200
December	14.7	56,200	14.1	52,560
January	14.1	52,560	14.1	52,560
February	14.1	52,560	14.1	52,560
March	14.1	52,560	13.0	46,000
April	19.4	94,800	12.9	44,800
May	19.4	94,800	19.0	90,300
June	19.8	99,700	19.0	90,300
July	19.7	99,300	18.9	88,500
August	18.9	88,500	16.8	69,600
September	16.8	69,600	15.9	64,600
1947-1948				
October	16.0	65,000	15.9	64,600
November	16.0	64,600	15.9	64,600
December	16.0	64,600	15.9	64,600
January	16.0	64,600	15.9	64,600
February	16.0	64,600	15.9	64,600
March	16.0	64,600	14.8	55,500
April	15.8	63,800	12.0	40,000
May	22.7	130,500	17.5	77,200
June	19.6	95,200	18.0	81,000
July	17.9	80,400	17.7	79,100
August	18.3	83,600	17.8	79,400



Hebron Dam Spillway After Repair

THE TOPOGRAPHIC BRANCH

Department of the Interior

United States Geological Survey

Topographic maps are the most accurate and give information in the most usable form to show each hill, valley and stream to scale and the heights and slope of the ground surface. This information is necessary before engineers can plan and design reservoirs, canals and irrigation projects.

In cooperation with the U. S. Geological Survey, topographic maps covering 1,088 square miles had been covered in former years, and 609 square miles has been added in the last biennium.

The Geological Survey, in connection with the Missouri Basin Development program, has made extensive surveys in North Dakota in Burke, Divide, Williams, Renville, Bottineau, McHenry and Ward counties, covering 2,174 square miles. Cooperative mapping is planned and control surveys are in progress on five 15-minute quadrangles in Burleigh, Kidder and Morton counties and in the Wilton-Bismarck-Driscoll area.

Under the North Dakota Water Commission cooperative program, quadrangle maps have been published as follows:

Carrington	Cathay	Pelican Lake
Manfred	New Rockford	Lincoln Valley
Turtle Lake	Fessenden	Sheyenne Lake

Office processing has been completed on:

Carrington	Pace	Pelican Lake
New Rockford	Washburn	Manfred
Turtle Lake	Fessenden	Sheyenne Lake
Cathay		

Field contouring has been completed on:

Carrington	Cathay	Fessenden
Pace	Washburn	and started on Deapolis

New controls have been completed on:

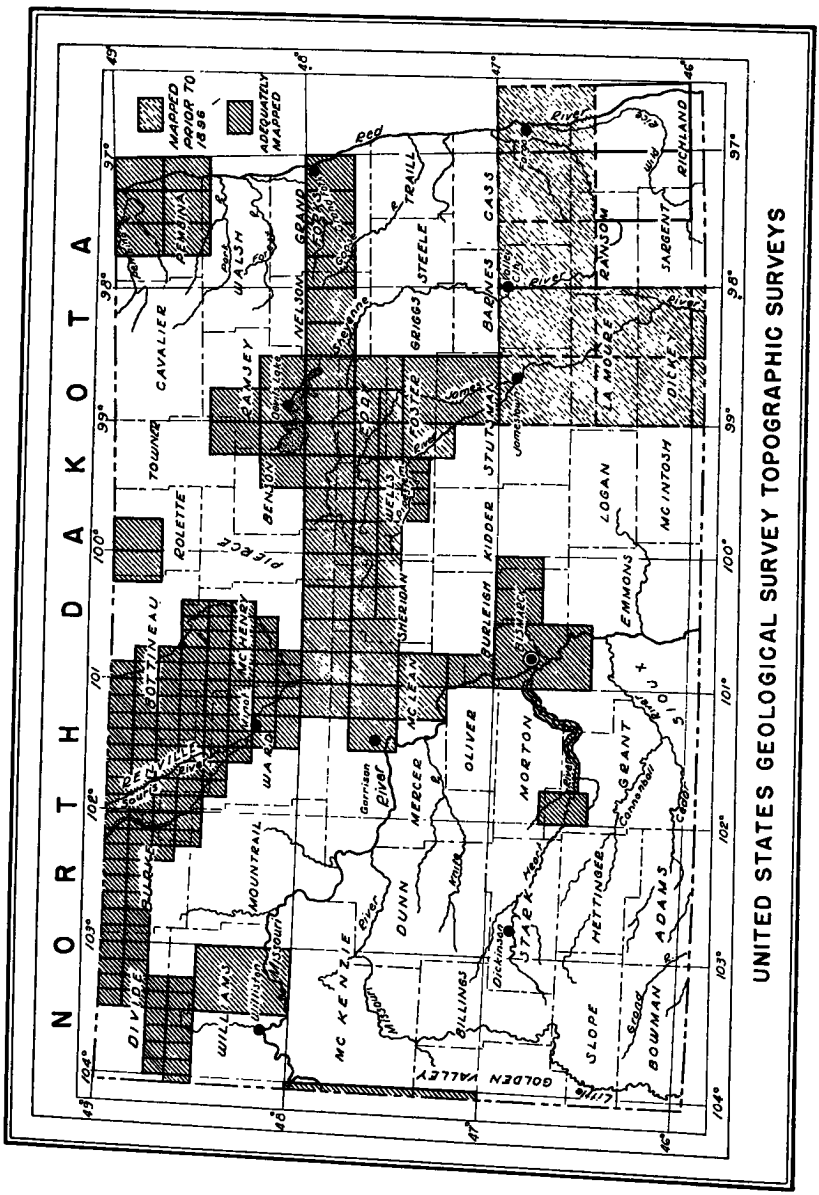
Wilton	Bismarck 1	Bismarck 2

and started on McKenzie Brittin No. 2 quadrangle.

New flying surveys have been completed for the Wilton, Bismarck 1, Bismarck 2, McKenzie and Driscoll quadrangles.

On the Missouri River Basin, quadrangles have been published (first proofs) on:

Alamo NE	Grenora	Brush Lake
Crosby SE	Bright Water Lake	Smoky Butte
Ambrose	Hanks	Zahl


NORTH DAKOTA
MAPPED PRIOR TO 1896
ADEQUATELY MAPPED
DIVIDE
BURKE
WILLIAMS
MOUNTRAIL
WARD
BOTTINEAU
ROLETTE
TOWNER
CAVALIER
PEMBINA
WALSH
RAMSEY
BENSON
PIERCE
NELSON
GRAND FORKS
NEW YORK
STEELE
TRAILL
GRIGGS
FOSTER
WELLS
SHERIDAN
MC HENRY
MC LEAN
MERCER
DUNN
MC KENZIE
BILLINGS
GOLDEN VALLEY
STARK
OLIVER
MORTON
BURLEIGH
KIDDER
STUTSMAN
BARNES
CASS
LA MOURE
RANSOM
SARGENT
RICHLAND
DICKEY
LOGAN
EMMONS
GRANT
HETTINGER
SLOPE
ADAMS
BOWMAN
MC INTOSH
Red River
Missouri River
Souris River
Sheyenne River
James River
Cannonball River
Heart River
Knife River
Little Missouri River
Dickinson
Bismarck
Jamestown
Fargo
Grand Forks
Devils Lake
Minot
Williston
Garrison
Mandan
Wahpeton
Lisbon
Oakes
Ellendale
Hettinger
Mott
Beach
Ashley
Wishek
Valley City
Cando
Rugby
Langdon
Carrington
Cooperstown
Jamestown
Fort Totten
Fort Yates
Fort Berthold
Fort Buford
Fort Lincoln
Fort Abraham Lincoln
Fort Pembina
Fort Ransom
Fort Seward
Fort Stevenson
Fort Union
Fort Rice
Fort Sully
Fort Pierre
Fort Bennett

Office processing has been completed on:

Alamo NE	Crosby	Kermit SW
Bowbells NW	Mohall	Portal
Columbus	Paulson	Tolley SE
Lignite	Donnybrook	Bowbells NE
Northgate	Kenmare	Brush Lake
Dokken SW	Pleasant SE	Crosby SW
Hanks	Stampede	Noonan
Pleasant SW	Bowbells	Pleasant NE
Stady	Bright Water Lake	Grenora
Zahl	Crosby SE	Larson
Ambrose	Norma	Smoky Butte
Bowbells SE	Pleasant	Woburn
	Flaxton SE	

Field work including most of the control was completed during the last two years, or will be completed by November 1, 1948, on all 847½ minute quadrangles in the Missouri-Souris group. Field work is also to be completed in the Minot NE and NW and Sawyer NE, NW, and SE quadrangles.

New flying surveys have been completed on the Jamestown and Pingree 30′ quadrangles, and will be completed this summer on the Missouri-Souris extension.

Plans for the North Dakota State Water Conservation Commission cooperative program for the fiscal year ending June 30, 1949, include the completion through publication of the Pace and Washburn quadrangles; the completion through preparation for inking of the Deapolis quadrangle; the multiple compilation and part of the field contouring for the Wilton quadrangle; the multiplex compilation for the Bismarck 7½, Mandan, Bismarck 15 n/2, Bismarck 1 SW, and Menoken 2/4 (Bismarck No. 1) quadrangles; and the completion of the primary control for the McKenzie and Driscoll quadrangles.

Plans for the Missouri Basin projects consist of the completion through publication of the quadrangles of the Missouri-Souris group, the control and subsequent mapping of the extension to this group which takes in all the quadrangles of the Souris River loop, and the mapping in 7½ minute units of the Drake-Jamestown project which consists of the following 15 minute quadrangles:

Aylmer (S/2)	Tokie (SW/4)	New Rockford
Oberon	Cathay	Sykeston (N/2)
Fessenden	Bowden (N/2)	Flora
Carrington	Maddock	Manfred
Selz	Sheyenne Lake (N/2)	Brantford

Planimetric maps for ground water investigations are to be prepared for the Brinsmade, Maza, Starkweather and Crary quadrangles.

Lignite eight feet thick has to be cut through in the tunnel. The lignite separates two strata of clay, at the Garrison dam.

Later programs include the mapping in 7½ minute units of the Pingree and Jamestown 30 minute quadrangles. The Jamestown Reservoir portion of these quadrangles will be mapped during the current field season.

North Dakota Research Foundation

GEOGRAPHICAL DATA CONCERNING NORTH DAKOTA

By Alex Burr

I. Boundary Lines (to nearest tenth mile).
   A. North—310.0 miles—Approximately the 49° parallel.
   B. East—213.5 miles—air-line-river boundary approximately 416 miles.
   C. South—360.6 miles—7th Standard parallel.
   D. West—210.8 miles—27th Standard meridian.

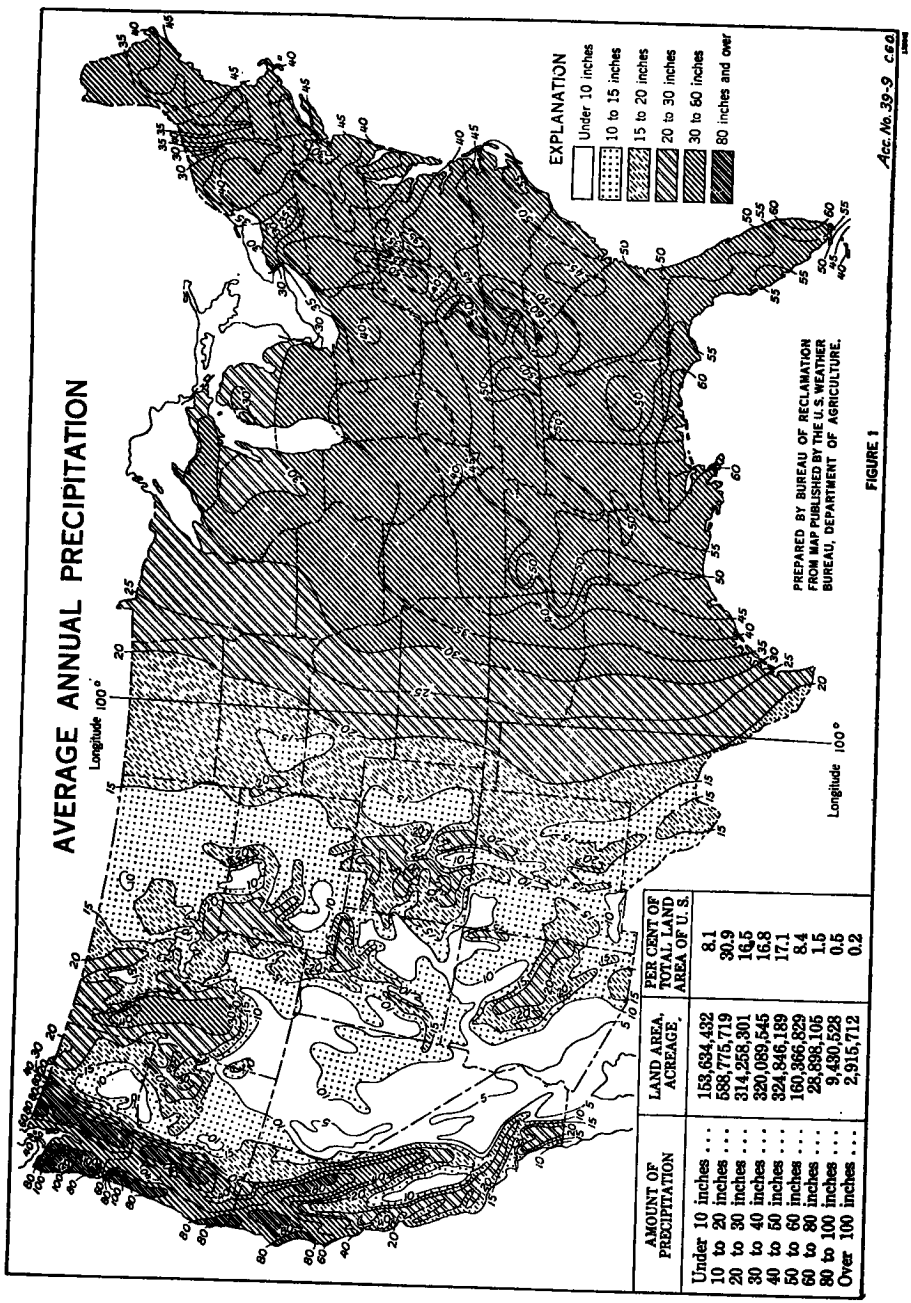
II. Boundary Corners (to nearest second of latitude or longitude).
   A. Northeast—49° 00′ 02″ N. Lat.; 97° 13′ 41″ W. Long.
   B. Southeast—45° 56′ 07″ N. Lat.; 96° 33′ 41″ W. Long.
   C. Southwest—45° 56′ 43″ N. Lat.; 104° 02′ 17″ W. Long.
   D. Northwest—49° 00′ 00″ N. Lat.; 104° 02′ 53″ W. Long.

III. Areas
   A. Of State ..... 70,665 Square Miles
      1. Land area ..... 70,054 Square Miles
      2. Water area ..... 611 Square Miles
   B. Of Basins (Based on line of Bureau of Reclamation)
      1. Red-Souris-Devils Lake to Hudson's Bay 29,500 Sq. M. (Approx.)
      2. Missouri to Gulf of Mexico..... 41,200 Sq. M. (Approx.)

MOTOR FUELS AND OILS FROM LIGNITE COAL

It has been demonstrated under laboratory tests at the North Dakota State University and at other points that motor fuels and oils can be produced from lignite coal, of which it is estimated that western North Dakota has more than six billion tons. The decreasing production of motor fuels and oils, with rationing in some areas, will without doubt speed up the utilization of this immense deposit of lignite, said to be about half of the coal in the United States.

Congress authorized the construction of a laboratory at the North Dakota University to cost $550,000 and appropriated $250,000 for work for the first twelve months. This is to enable the chemists to produce motor fuels and oils and other by-products of lignite coal under commercial conditions and quantities, to demonstrate that production on a quantity basis can be made at a cost to compete with the markets, in the hope that this information will induce large producers to engage



AMOUNT OF PRECIPITATION	LAND AREA, ACREAGE	PER CENT OF TOTAL LAND AREA OF U. S.
Under 10 inches ...	153,634,432	8.1
10 to 20 inches ...	588,775,719	30.9
20 to 30 inches ...	314,258,301	16.5
30 to 40 inches ...	320,089,545	16.8
40 to 50 inches ...	324,846,189	17.1
50 to 60 inches ...	160,366,829	8.4
60 to 80 inches ...	28,898,105	1.5
80 to 100 inches ...	9,430,528	0.5
Over 100 inches ...	2,915,712	0.2

in the industry in North Dakota. About seventy five other by-products of lignite coal can be extracted, altogether giving promise of a big industry for the future. Some of the large oil companies are experimenting in synthetic liquid fuel plants, at least two with natural gas and one will use coal.

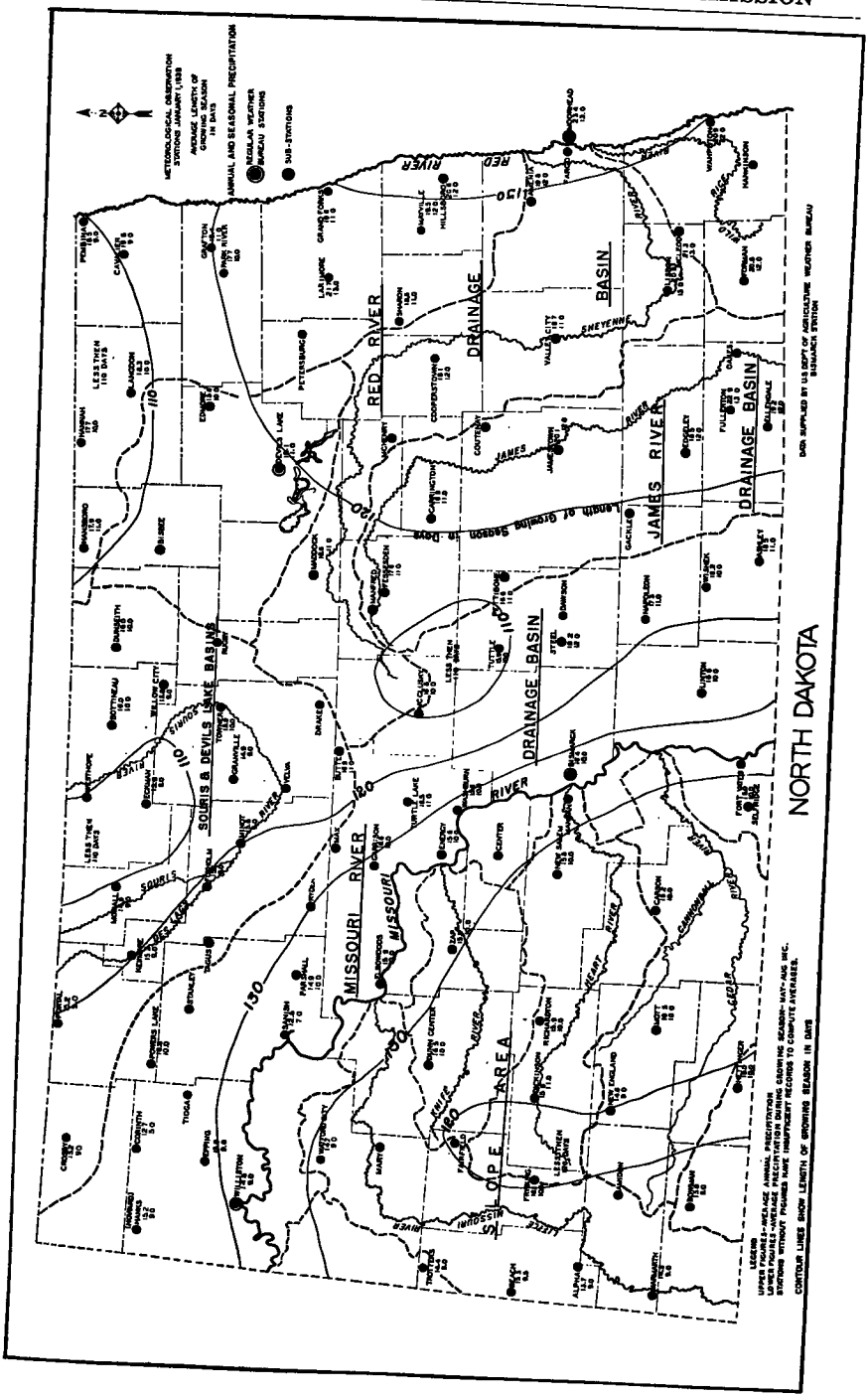
UNITED STATES WEATHER BUREAU

As of 1948 there are four first-order Weather Bureau stations in North Dakota and ten Airway stations, all rendering twenty-four hour service. There are also 125 cooperative weather observers in North Dakota, supervised by the Bismarck office. These cooperative weather observers take daily readings, recording the high temperature, low temperature, 24-hour precipitation, sky condition and wind. The observers are scattered over the state, usually two or three to the county. They receive no pay for their work, but there are many public-spirited citizens who are interested in the weather in all counties so that little difficulty is experienced in finding observers. Beginning with July, 1948, weather records were put on punch cards with International Business Machines. With this method much more data are available with less work.

There are also records kept from more than 100 rain gages owned by state agencies, individuals, companies and Federal agencies. About twenty-five of the cooperative observers have recording gages which indicate the time and rate of fall besides the amount. The rate of fall is important for determining the run-off from the fall per hour. One-half inch of rain falling slowly over a period of six hours is worth more to the state than an inch that falls in an hour. Fortunately, rainfalls of more than one inch per hour occur only twice in the average year in North Dakota.

The first weather records in North Dakota were made by Lewis & Clark in 1804-5. The army began regular observations in 1860 but a good distribution of stations was not secured until 1892 when 40 were in operation. Complete records for more than 50 years are available to the public and they include precipitation, temperature, sunshine, wind, humidity, state of the sky, etc. Records made to a distance of 12 miles above the earth's surface by means of recording instruments sent up by helium filled balloons are also available. Weather maps showing weather conditions in all parts of the United States are drawn four times daily and forecasts are issued every six hours.

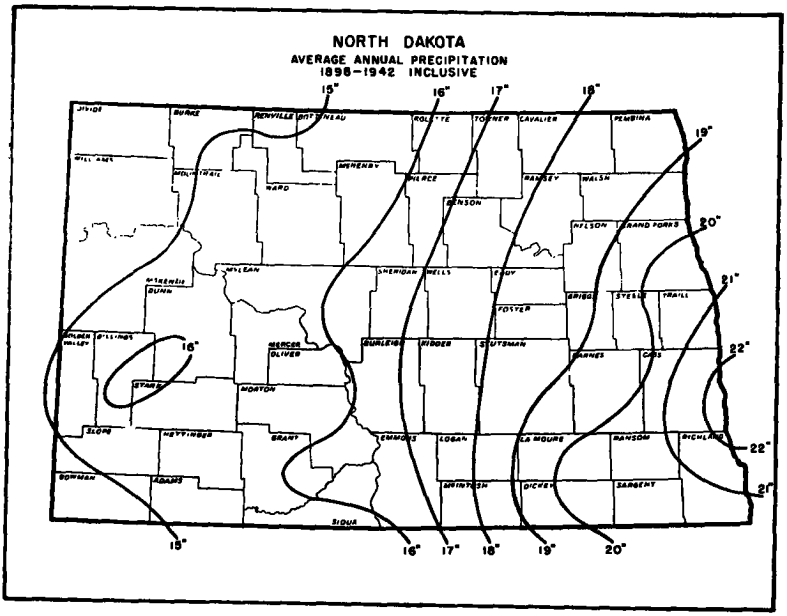
In an examination of North Dakota weather records for the past seventy-five years, there is found no evidence of any progressive change in temperature or in the amount of rain and snow. An outstanding period of extremes occurred between 1936 and 1945. During this decade, North Dakota experienced its highest and lowest temperatures and its driest and wettest years.

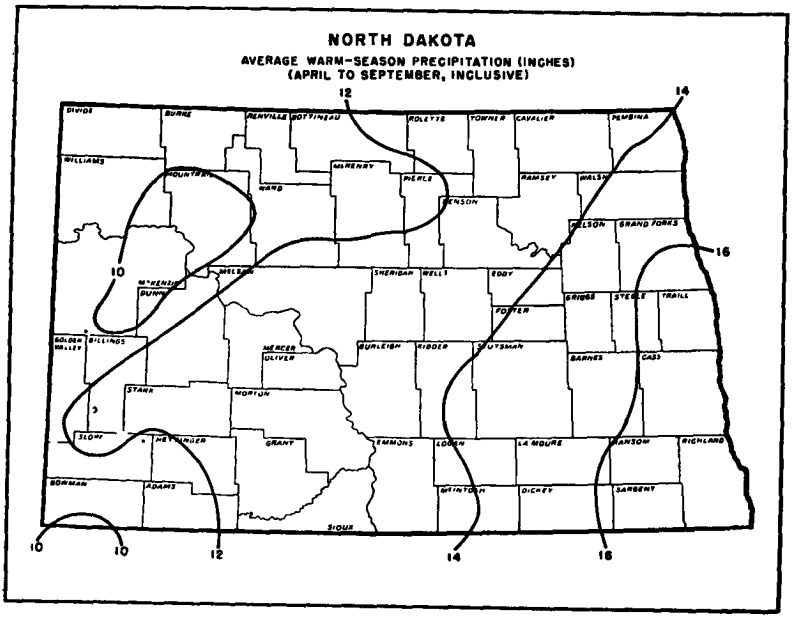

METEOROLOGICAL OBSERVATION STATIONS JANUARY, 1938
AVERAGE LENGTH OF GROWING SEASON IN DAYS
ANNUAL AND SEASONAL PRECIPITATION
REGULAR WEATHER BUREAU STATIONS
SUB-STATIONS
NORTH DAKOTA
RED RIVER DRAINAGE BASIN
JAMES RIVER DRAINAGE BASIN
MISSOURI RIVER DRAINAGE BASIN
SOURIS & DEVILS LAKE BASINS
LOPE AREA
Length of Growing Season in Days
DATA SUPPLIED BY U.S. DEPT. OF AGRICULTURE WEATHER BUREAU BISMARCK STATION
LEGEND
UPPER FIGURES-AVERAGE ANNUAL PRECIPITATION
LOWER FIGURES-AVERAGE PRECIPITATION DURING GROWING SEASON-MAY-AUG INC.
STATIONS WITHOUT FIGURES HAVE INSUFFICIENT RECORDS TO COMPUTE AVERAGES.
CONTOUR LINES SHOW LENGTH OF GROWING SEASON IN DAYS

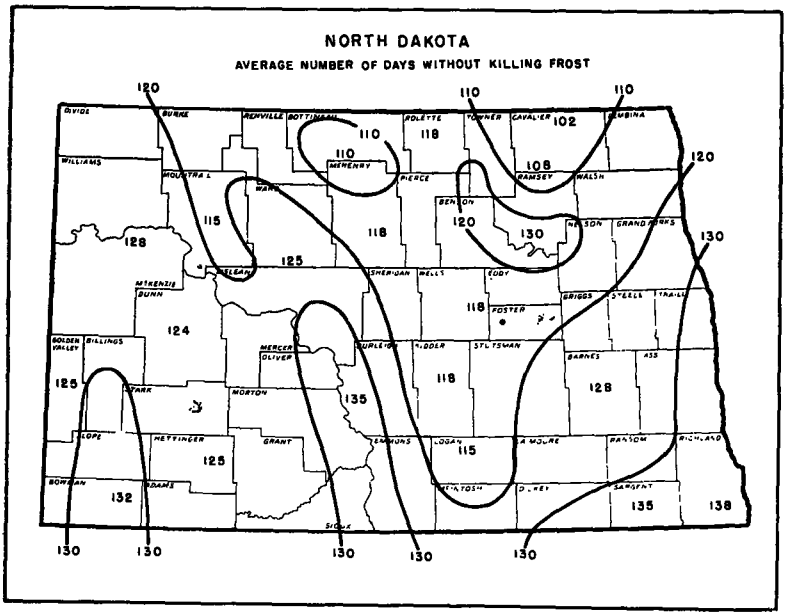
Climate is a natural resource that cannot be exhausted by exploitation as is the case with most natural resources, such as soils, forests and mines. As civilization has become more complex, our dependence upon an intimate knowledge of climate and weather has increased. Today this knowledge is so indispensable that every civilized country has an extensive weather service. While it is impossible for man to change the climate materially, it is possible for him to plan his activities in such a manner that he will realize the maximum benefit from the forces of nature.

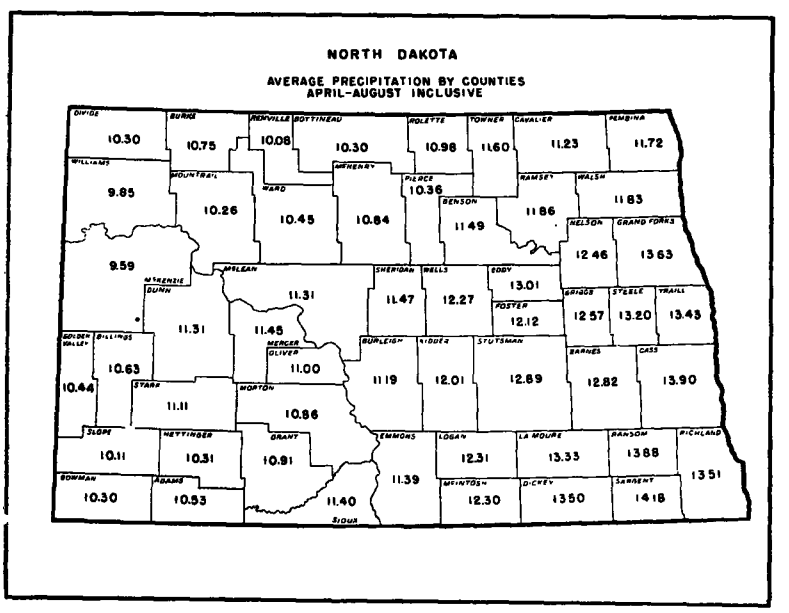
"Climate and Weather in North Dakota" prepared by Meteorologist Frank J. Bavendick and published by the State Water Conservation Commission, contains a digest of records for seventy-five years. It notes unusual and unfavorable weather conditions to prepare residents for possible recurrences in future years. This booklet contains a wealth of information of the vagaries of North Dakota weather, includes floods, blizzards, drought, dust storms, hail, precipitation, snowfall, sunshine, etc. A charge of $1 is made to cover a part of the cost. The first issue of 1,000 was exhausted and a second issue printed to meet the demand.

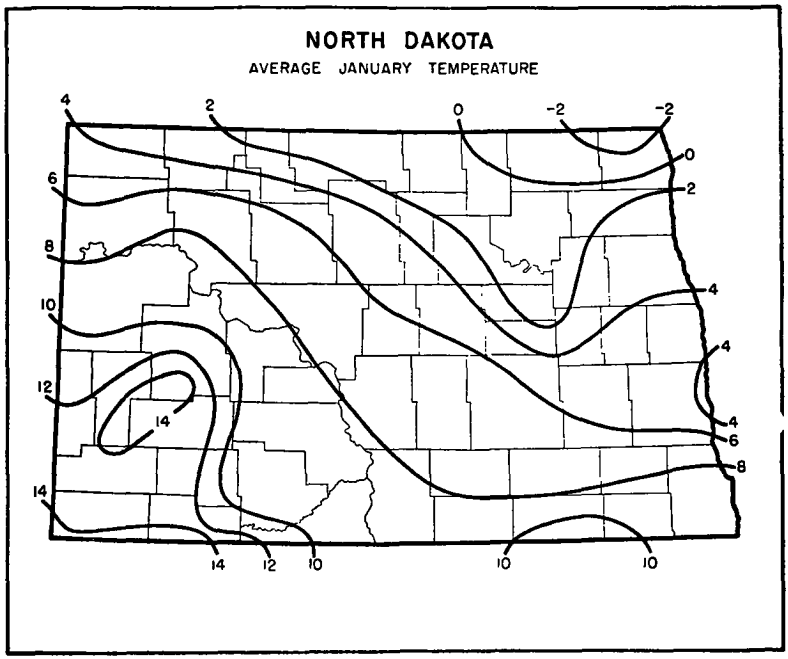
Rainfall has been above normal for seven out of the past nine years and need for irrigation has not been so apparent, and dry farming methods have been satisfactory. However, Weather Bureau records for the past 75 years indicate that on the average six out of eleven years have had insufficient rainfall to produce a paying crop, in western North Dakota on seven out of nine years. The only other long period of continued good moisture supply during the 75 years recorded was in 1899 to 1904. A drouth preceded and followed this period, hence it seems safe to conclude that this area is approaching a period of drouth years.

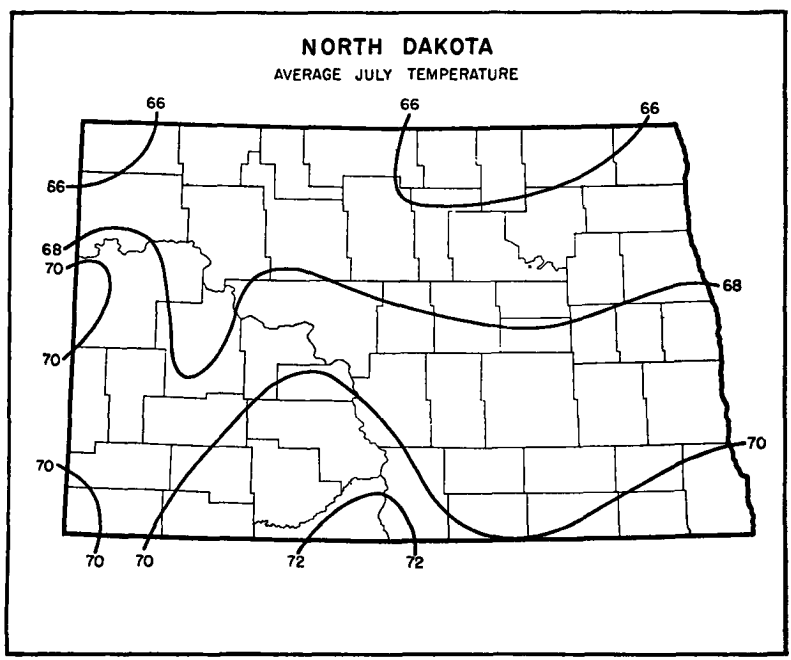

NORTH DAKOTA
AVERAGE ANNUAL PRECIPITATION
1898-1942 INCLUSIVE
15"
16"
17"
18"
19"
20"
21"
22"
DIVIDE
BURKE
RENVILLE
BOTTINEAU
ROLETTE
TOWNER
CAVALIER
PEMBINA
WILLIAMS
MOUNTRAIL
WARD
MCHENRY
PIERCE
RAMSEY
WALSH
BENSON
NELSON
GRAND FORKS
MCKENZIE
DUNN
MCLEAN
SHERIDAN
WELLS
EDDY
FOSTER
GRIGGS
STEELE
TRAILL
GOLDEN VALLEY
BILLINGS
MERCER
OLIVER
BURLEIGH
KIDDER
STUTSMAN
BARNES
CASS
STARK
MORTON
SLOPE
HETTINGER
GRANT
EMMONS
LOGAN
LA MOURE
RANSOM
RICHLAND
BOWMAN
ADAMS
MCINTOSH
DICKEY
SARGENT
SIOUX

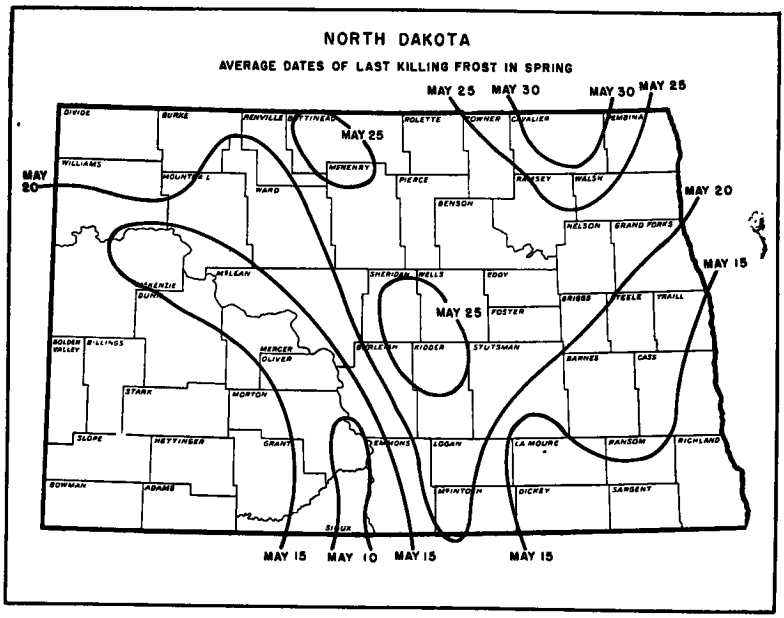

NORTH DAKOTA
AVERAGE WARM-SEASON PRECIPITATION (INCHES)
(APRIL TO SEPTEMBER, INCLUSIVE)
10
12
14
16
DIVIDE
BURKE
RENVILLE
BOTTINEAU
ROLETTE
TOWNER
CAVALIER
PEMBINA
WILLIAMS
MOUNTRAIL
WARD
MCHENRY
PIERCE
RAMSEY
WALSH
BENSON
NELSON
GRAND FORKS
MCKENZIE
DUNN
MCLEAN
SHERIDAN
WELLS
EDDY
FOSTER
GRIGGS
STEELE
TRAILL
GOLDEN VALLEY
BILLINGS
MERCER
OLIVER
BURLEIGH
KIDDER
STUTSMAN
BARNES
CASS
STARK
MORTON
SLOPE
HETTINGER
GRANT
EMMONS
LOGAN
LA MOURE
RANSOM
RICHLAND
BOWMAN
ADAMS
MCINTOSH
DICKEY
SARGENT
SIOUX

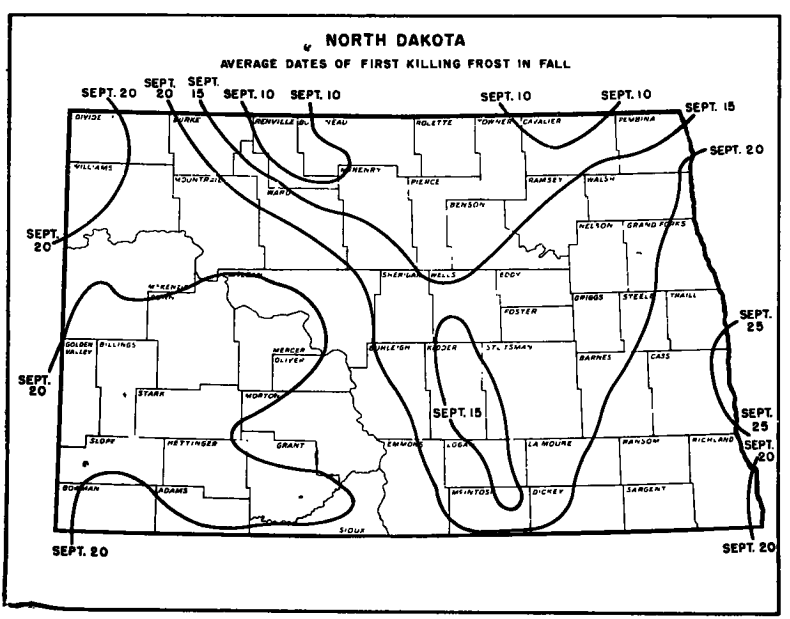

NORTH DAKOTA
AVERAGE NUMBER OF DAYS WITHOUT KILLING FROST
DIVIDE
BURKE
RENVILLE
BOTTINEAU
ROLETTE
TOWNER
CAVALIER
PEMBINA
WILLIAMS
MOUNTRAIL
MCHENRY
PIERCE
RAMSEY
WALSH
WARD
BENSON
NELSON
GRAND FORKS
MCLEAN
SHERIDAN
WELLS
EDDY
MCKENZIE
DUNN
FOSTER
GRIGGS
STEELE
TRAILL
GOLDEN VALLEY
BILLINGS
MERCER
OLIVER
BURLEIGH
KIDDER
STUTSMAN
BARNES
CASS
STARK
MORTON
EMMONS
LOGAN
LA MOURE
RANSOM
RICHLAND
SLOPE
HETTINGER
GRANT
BOWMAN
ADAMS
MCINTOSH
DICKEY
SARGENT
SIOUX
120
110
110
110
118
102
108
120
115
128
125
118
120
130
130
124
118
125
135
118
128
125
115
125
132
135
138
130
130
130
130
130


NORTH DAKOTA
AVERAGE PRECIPITATION BY COUNTIES
APRIL-AUGUST INCLUSIVE
DIVIDE
BURKE
RENVILLE
BOTTINEAU
ROLETTE
TOWNER
CAVALIER
PEMBINA
WILLIAMS
MOUNTRAIL
MCHENRY
PIERCE
RAMSEY
WALSH
WARD
BENSON
NELSON
GRAND FORKS
MCLEAN
SHERIDAN
WELLS
EDDY
MCKENZIE
DUNN
FOSTER
GRIGGS
STEELE
TRAILL
GOLDEN VALLEY
BILLINGS
MERCER
OLIVER
BURLEIGH
KIDDER
STUTSMAN
BARNES
CASS
STARK
MORTON
EMMONS
LOGAN
LA MOURE
RANSOM
RICHLAND
SLOPE
HETTINGER
GRANT
BOWMAN
ADAMS
MCINTOSH
DICKEY
SARGENT
SIOUX
10.30
10.75
10.08
10.30
10.98
11.60
11.23
11.72
9.85
10.26
10.45
10.84
10.36
11.49
11.86
11.83
9.59
12.46
13.63
11.31
11.47
12.27
13.01
11.31
11.45
12.57
13.20
13.45
12.12
10.63
11.00
11.19
12.01
12.89
12.82
13.90
10.44
11.11
10.86
10.11
10.31
10.91
11.39
12.31
13.33
13.88
13.51
10.30
10.53
11.40
12.30
13.50
14.18


NORTH DAKOTA
AVERAGE JANUARY TEMPERATURE
4
2
0
-2
-2
0
2
6
8
4
10
4
12
14
4
6
8
14
14
12
10
10
10


NORTH DAKOTA
AVERAGE JULY TEMPERATURE
66
66
66
66
68
70
68
70
70
70
70
70
72
72


NORTH DAKOTA
AVERAGE DATES OF LAST KILLING FROST IN SPRING
MAY 25
MAY 30
MAY 30
MAY 25
MAY 25
MAY 20
MAY 20
MAY 15
MAY 25
MAY 15
MAY 10
MAY 15
MAY 15
DIVIDE
BURKE
RENVILLE
BOTTINEAU
ROLETTE
TOWNER
CAVALIER
PEMBINA
WILLIAMS
MOUNTRAIL
WARD
MCHENRY
PIERCE
RAMSEY
WALSH
BENSON
NELSON
GRAND FORKS
MCLEAN
SHERIDAN
WELLS
EDDY
GRIGGS
STEELE
TRAILL
FOSTER
BURLEIGH
KIDDER
STUTSMAN
BARNES
CASS
GOLDEN VALLEY
BILLINGS
MERCER
OLIVER
STARK
MORTON
SLOPE
HETTINGER
GRANT
EMMONS
LOGAN
LA MOURE
RANSOM
RICHLAND
BOWMAN
ADAMS
MCINTOSH
DICKEY
SARGENT
SIOUX


NORTH DAKOTA
AVERAGE DATES OF FIRST KILLING FROST IN FALL
SEPT. 20
SEPT. 20
SEPT. 15
SEPT. 10
SEPT. 10
SEPT. 10
SEPT. 10
SEPT. 15
SEPT. 20
SEPT. 20
SEPT. 20
SEPT. 25
SEPT. 20
SEPT. 15
SEPT. 25
SEPT. 20
SEPT. 20
SEPT. 20
DIVIDE
BURKE
RENVILLE
ROLETTE
TOWNER
CAVALIER
PEMBINA
WILLIAMS
MOUNTRAIL
WARD
MCHENRY
PIERCE
RAMSEY
WALSH
BENSON
NELSON
GRAND FORKS
SHERIDAN
WELLS
EDDY
GRIGGS
STEELE
TRAILL
FOSTER
GOLDEN VALLEY
BILLINGS
MERCER
OLIVER
BURLEIGH
KIDDER
STUTSMAN
BARNES
CASS
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MORTON
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RICHLAND
BOWMAN
ADAMS
MCINTOSH
DICKEY
SARGENT
SIOUX

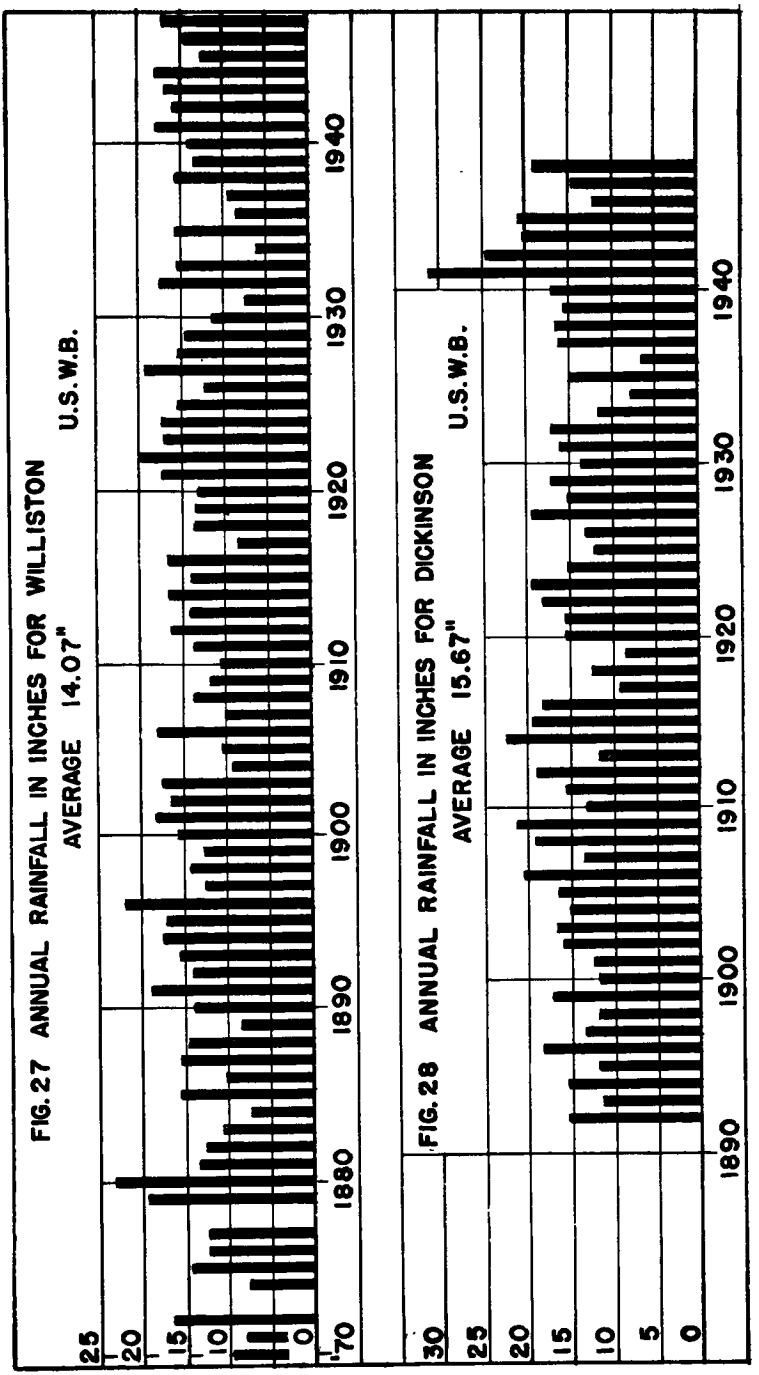


FIG. 27 ANNUAL RAINFALL IN INCHES FOR WILLISTON
AVERAGE 14.07"
U.S.W.B.
25
20
15
10
0
'70
1880
1890
1900
1910
1920
1930
1940
FIG. 28 ANNUAL RAINFALL IN INCHES FOR DICKINSON
AVERAGE 15.67"
U.S.W.B.
30
25
20
15
10
5
0
1890
1900
1910
1920
1930
1940

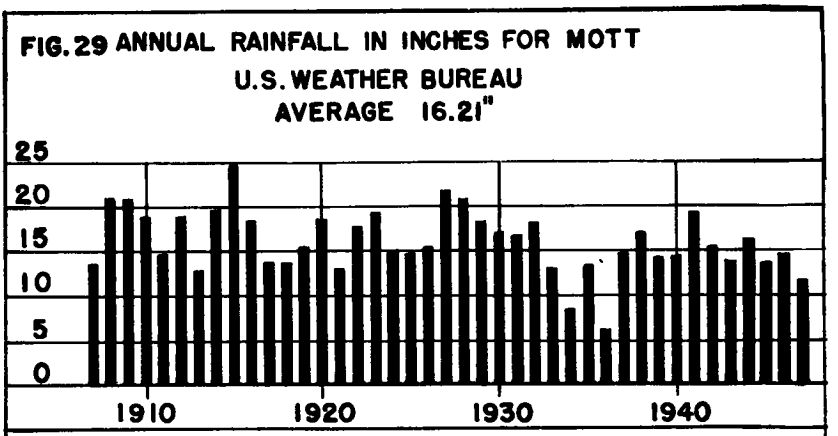


FIG. 29 ANNUAL RAINFALL IN INCHES FOR MOTT
U.S. WEATHER BUREAU
AVERAGE 16.21"
25
20
15
10
5
0
1910
1920
1930
1940

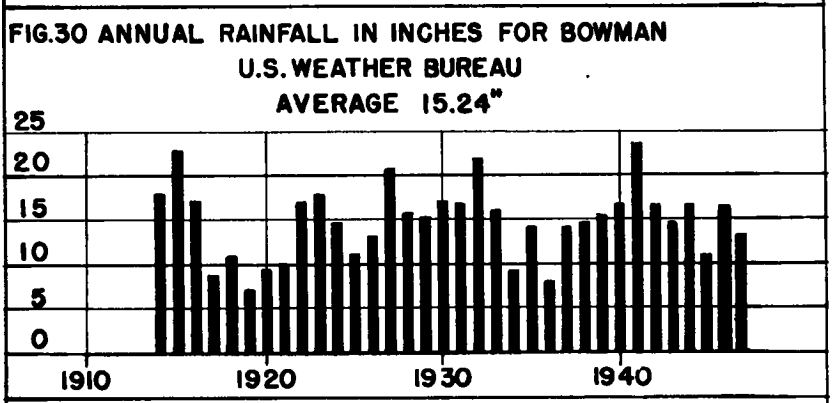


FIG. 30 ANNUAL RAINFALL IN INCHES FOR BOWMAN
U.S. WEATHER BUREAU
AVERAGE 15.24"
25
20
15
10
5
0
1910
1920
1930
1940

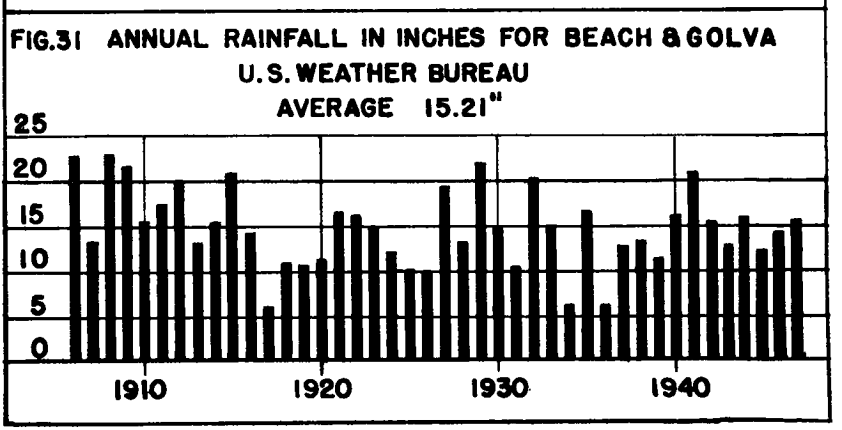


FIG. 31 ANNUAL RAINFALL IN INCHES FOR BEACH & GOLVA
U.S. WEATHER BUREAU
AVERAGE 15.21"
25
20
15
10
5
0
1910
1920
1930
1940

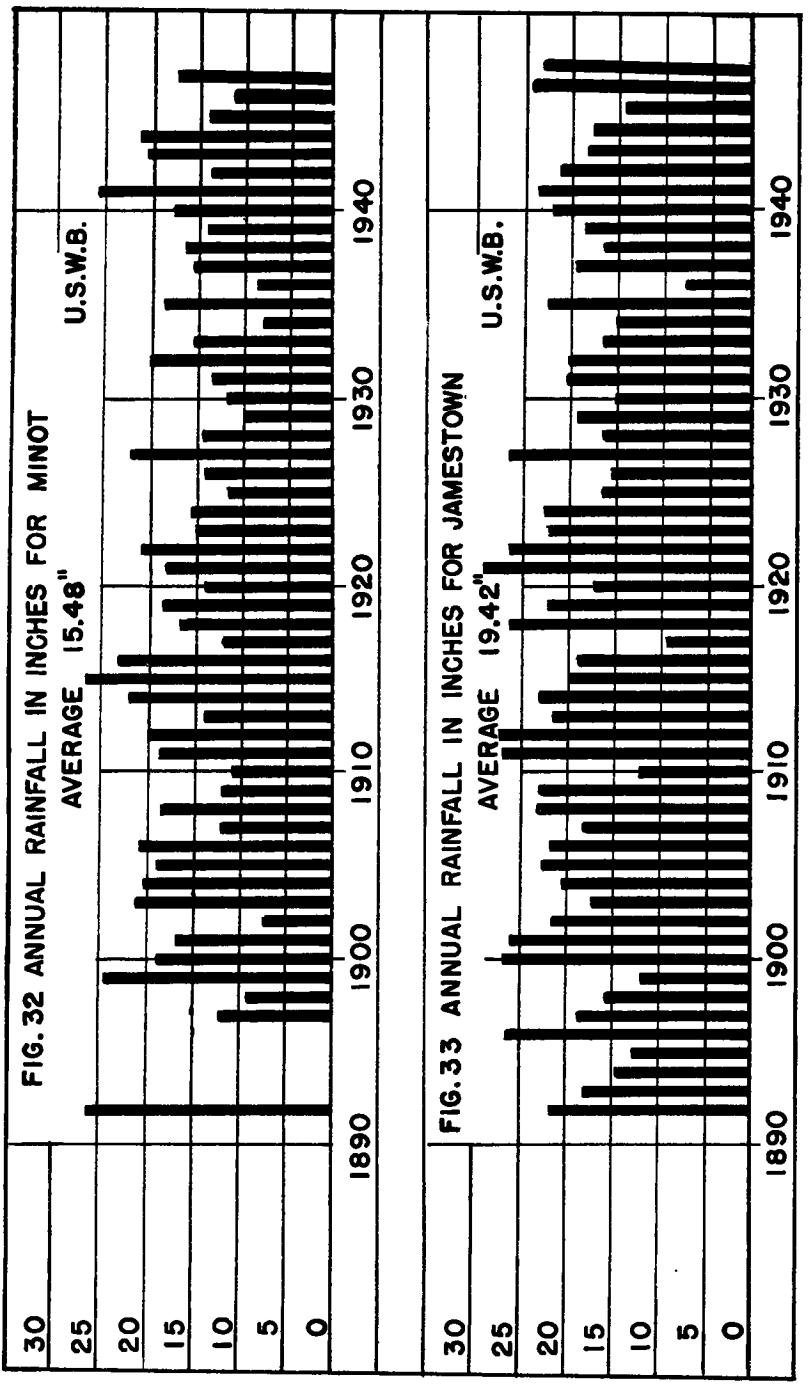


FIG. 32 ANNUAL RAINFALL IN INCHES FOR MINOT
AVERAGE 15.48"
U.S.W.B.
30
25
20
15
10
5
0
1890
1900
1910
1920
1930
1940
FIG. 33 ANNUAL RAINFALL IN INCHES FOR JAMESTOWN
AVERAGE 19.42"
U.S.W.B.
30
25
20
15
10
5
0
1890
1900
1910
1920
1930
1940

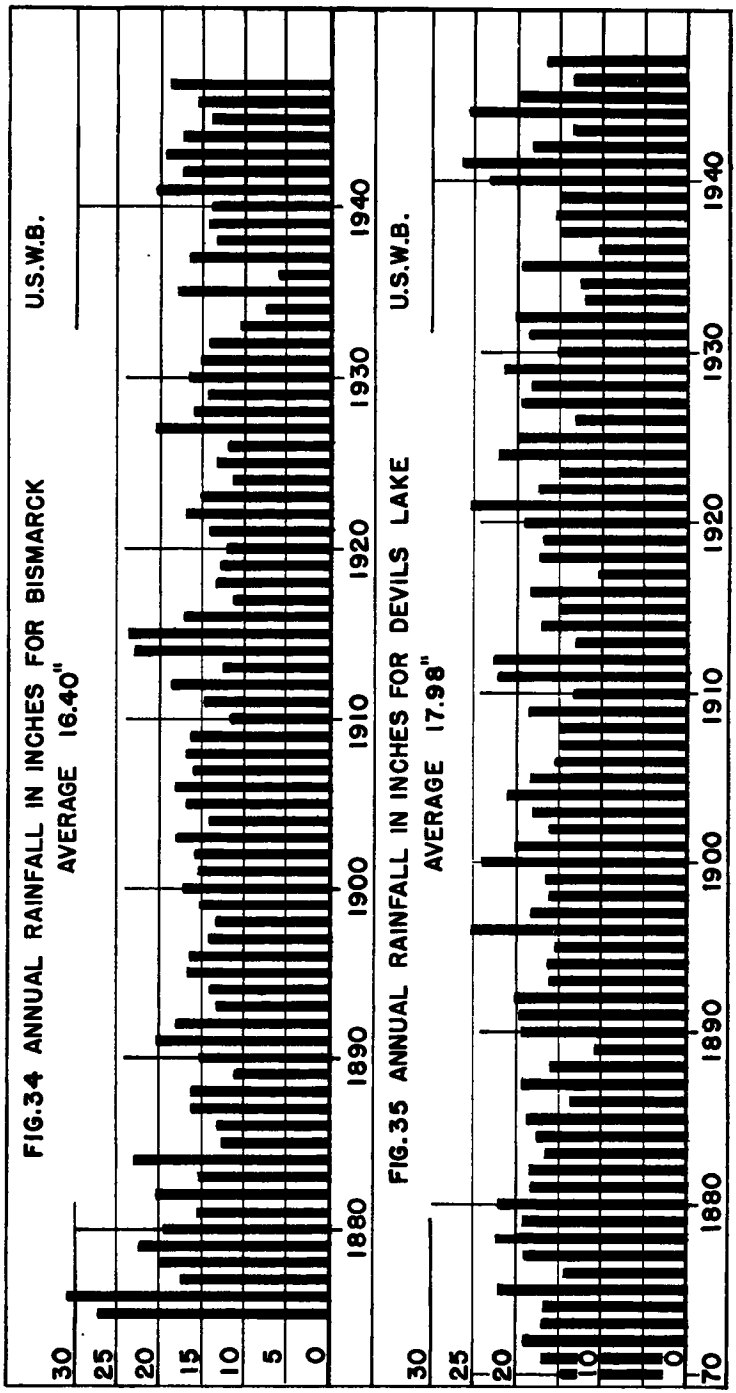


FIG.34 ANNUAL RAINFALL IN INCHES FOR BISMARCK
AVERAGE 16.40"
U.S.W.B.
30
25
20
15
10
5
0
1880
1890
1900
1910
1920
1930
1940
FIG.35 ANNUAL RAINFALL IN INCHES FOR DEVILS LAKE
AVERAGE 17.98"
U.S.W.B.
30
25
20
10
0
70
1880
1890
1900
1910
1920
1930
1940

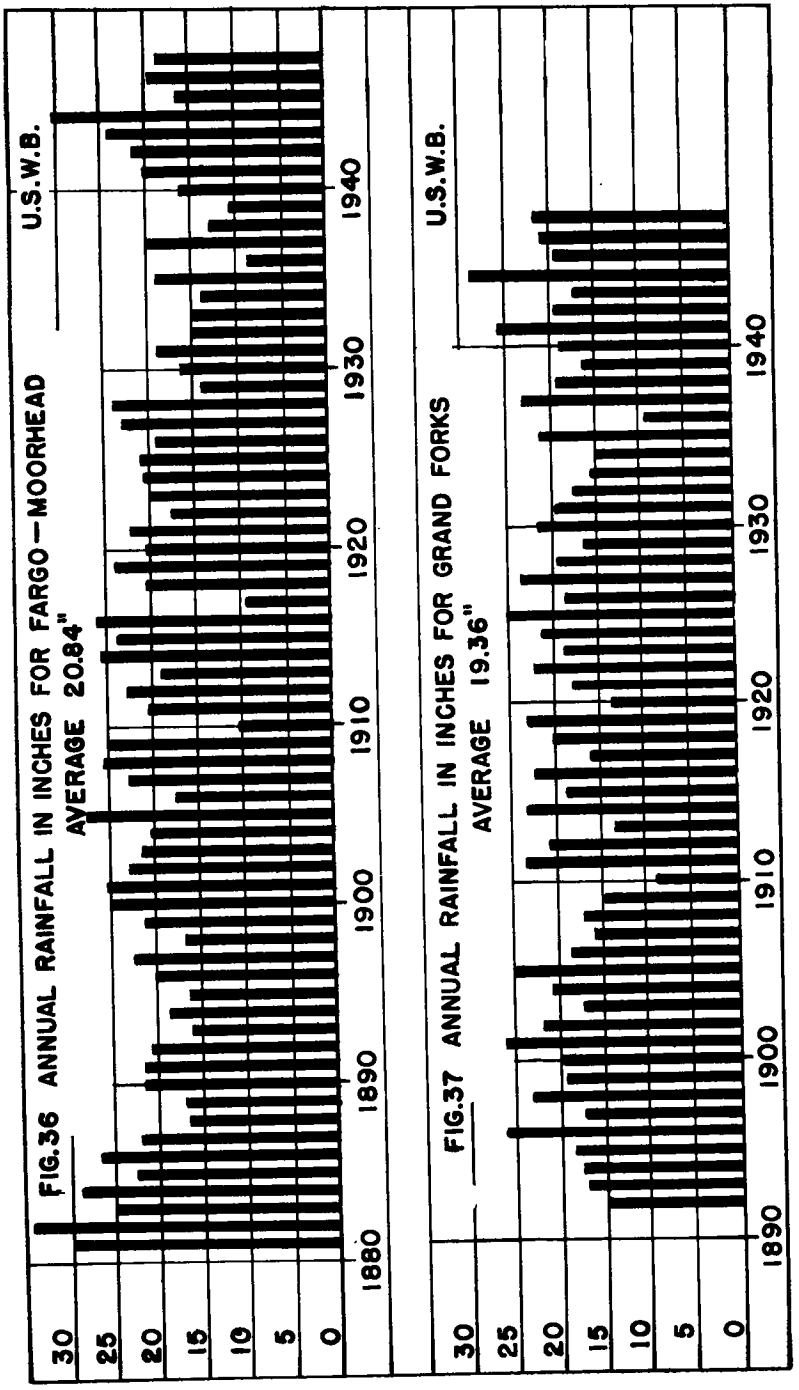


FIG.36 ANNUAL RAINFALL IN INCHES FOR FARGO—MOORHEAD
AVERAGE 20.84"
U.S.W.B.
30
25
20
15
10
5
0
1880
1890
1900
1910
1920
1930
1940
FIG.37 ANNUAL RAINFALL IN INCHES FOR GRAND FORKS
AVERAGE 19.36"
U.S.W.B.
30
25
20
15
10
5
0
1890
1900
1910
1920
1930
1940

WET AND DRY SEASONS FOR FIVE HUNDRED FORTY YEARS IN THE NORTHERN PLAINS AS DETERMINED FROM TREE RINGS AND GROWTH

By Geo. F. Will, Bismarck

Climate and weather statistics in this area date back only about seventy-five years, but Geo. F. Will of Bismarck has evolved a reasonably accurate tree ring chart of the seasons and weather for a period of five hundred and forty years.

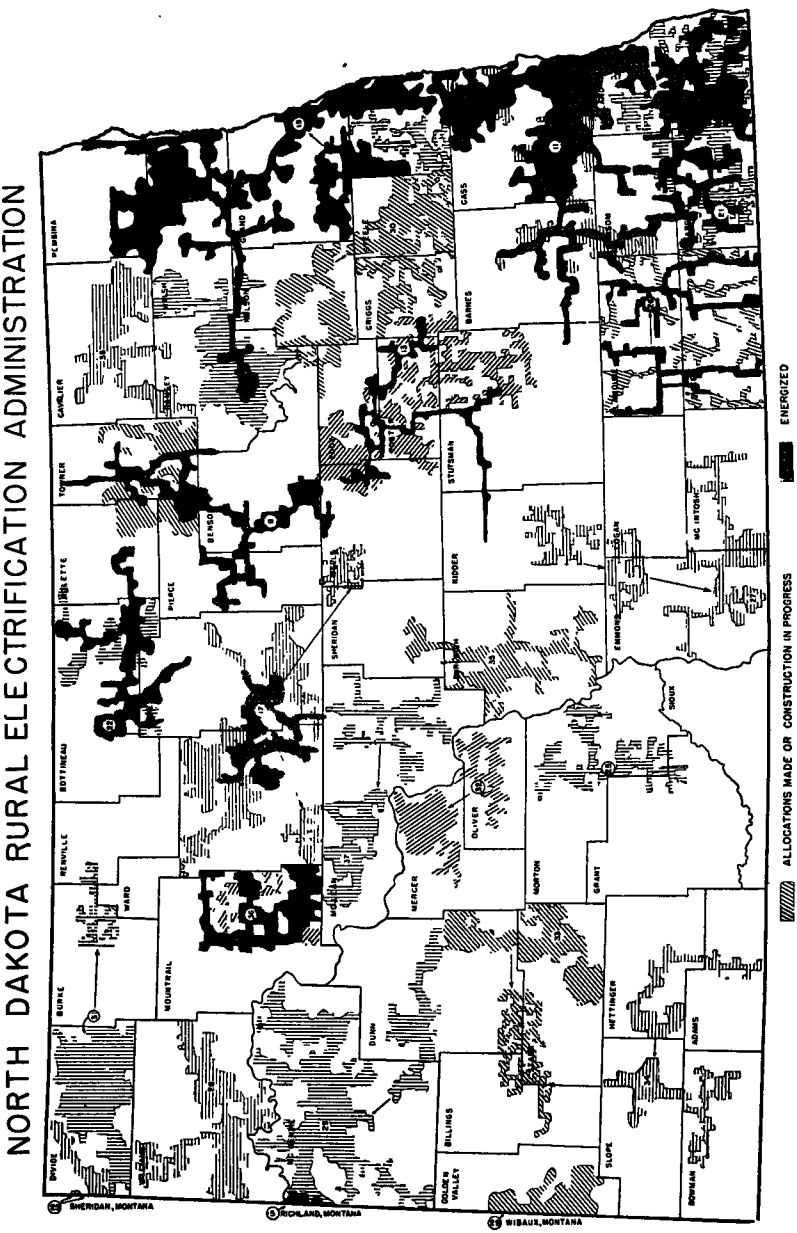
This chart depicted by the rings showing growth of trees confirms the records of the weather bureau that the periods of dry seasons slightly exceed the periods of wet seasons, indicating the need of irrigation to establish a reliable agriculture and furnish necessary feed for livestock during periods of drought.

This tree ring chart shows one wet period of thirty-nine years, one of twenty years, one of nineteen years and one of eighteen years. The longest dry period is sixteen years, but there are seven dry periods of thirteen to sixteen years. Some dry or wet periods lasted only one to four years.

Dean H. L. Walster comments: "Mr. Will's contribution to the history of North Dakota climate establishes the fact that its recent variability has occurred many times in past centuries. It further establishes that relatively wet and relatively dry periods have not occurred according to any cyclic or rhythmic pattern.

"Whether or not irrigation systems can be designed and operated so as to permit periods of disuse is open to question. The alternative would appear to be finding of ways and means for the most economic supplemental use of water so that the irrigation works could be used to advantage every year. When the proper principles are fully recognized and followed, irrigation will find its proper place in both the "wet" and "dry" years which lie ahead."

(See graph and story at the end of this report.)


NORTH DAKOTA RURAL ELECTRIFICATION ADMINISTRATION
PEMBINA
CAVALIER
TOWNER
LAFFITE
BOTTINEAU
RENVILLE
BURKE
DIVIDE
WARD
MOUNTRAIL
BENSON
PIERCE
SHERIDAN
WELLS
FOSTER
EDDY
GRIGGS
STEELE
TRAILL
CASS
BARNES
STUTSMAN
RUDDER
EMMONS
LOGAN
MC INTOSH
DUNN
MERCER
OLIVER
MORTON
GRANT
SIOUX
BILLINGS
GOLDEN VALLEY
SLOPE
HETTINGER
ADAMS
BOWMAN
SHERIDAN, MONTANA
RICHLAND, MONTANA
WIBAUX, MONTANA
ALLOCATIONS MADE OR CONSTRUCTION IN PROGRESS
ENERGIZED

RURAL ELECTRIFICATION IN NORTH DAKOTA

Rural electrification made unprecedented gains in North Dakota during the period from June 30, 1946, to June 30, 1948. More miles of power lines were built, more consumers connected and more planning for the future perfected than during any other comparable period in the history of the state.

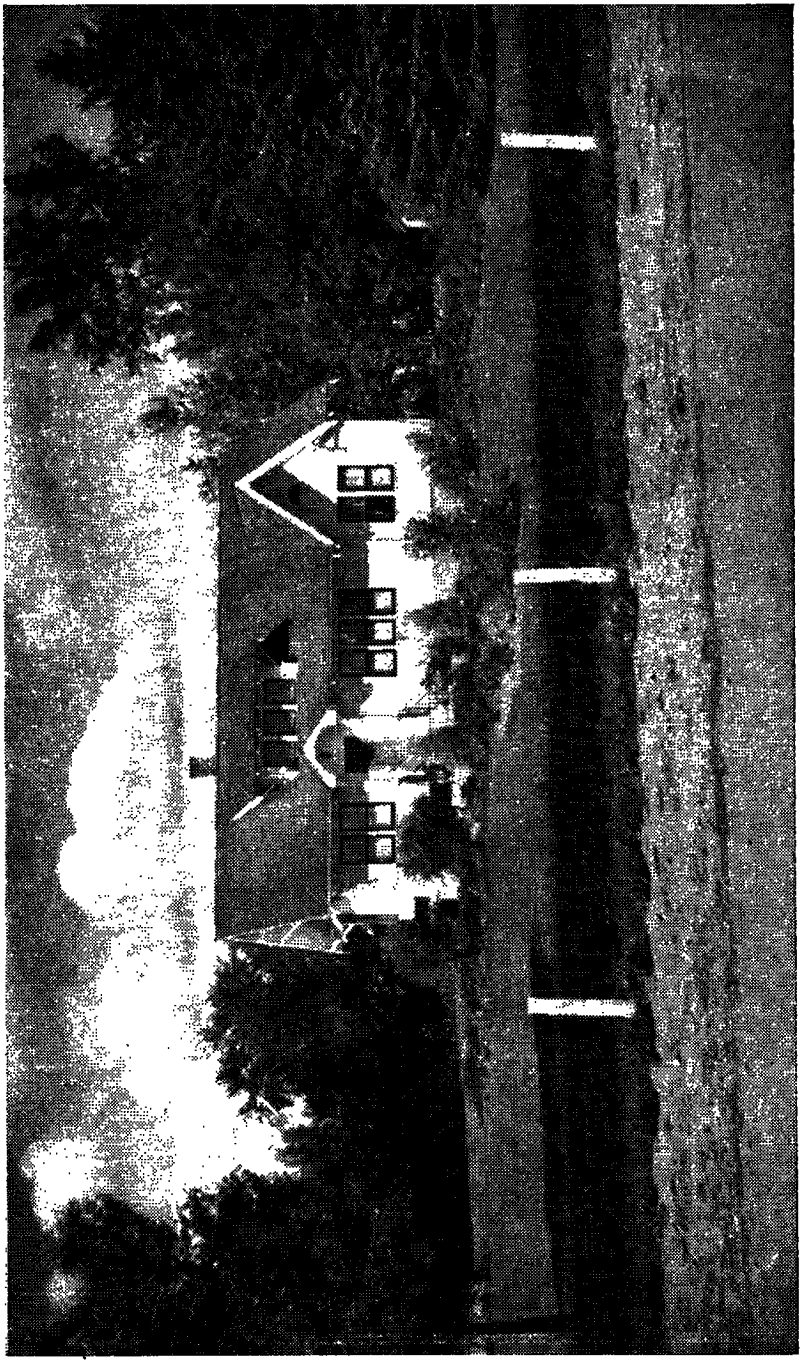
REA borrowers alone placed in operation 5,091 miles of lines, bringing electric service to 7,079 farms and other rural establishments. This is more than half of the REA-financed lines now in operation in the state, and about half of all the consumers receiving electric power from those lines. While this fact is important, the more important fact is that during this period the REA borrowers laid the groundwork to make electricity available to even a greater number of rural people. REA estimates that when all the plans made and approved during this period are carried out, rural electrification in North Dakota will approach and perhaps exceed fifty per cent.

Although North Dakota commercial power companies made important contributions to rural electrification in these and previous years, the story of the progress and the planning is largely the story of the REA borrowers. There are 23 such borrower groups in the state. Twenty-one are farmer-owned cooperatives, one is a federation of such cooperatives and the other is a commercial power company. It borrowed REA funds to finance the construction of a transmission line to deliver low-cost Fort Peck power to the cooperatives in the western and central regions of the state.

Since the start of the Federally-sponsored rural electrification program in 1935, REA has approved loans to North Dakota borrowers totaling $38,670,538. Of this amount, $22,208,497 has been advanced. On June 30, 1948, there was in operation 8,764 miles of lines serving 14,649 consumers. Fifty-six per cent of the loans were approved during the two-year period ending June 30, 1948. Seventy-two per cent of the funds were advanced during this period, 58 per cent of the lines were energized and 50 per cent of the consumers connected.

REA estimates that the loans approved will enable North Dakota borrowers to construct an additional 14,000 miles of lines that eventually will bring electric service to 19,700 more rural consumers. Construction of facilities to serve these consumers now is under way and is progressing as rapidly as the supply of materials, labor and power will permit.

During the fiscal years 1947 and 1948 the REA borrowers energized the initial sections of ten new power systems. These were systems of the Mor-Gran-Sou Electric Cooperative at Flasher, James Valley Electric Cooperative at Edgeley, Williams Electric Cooperative at Williston, McKenzie Electric Cooperative at Watford City, Sheyenne Valley Electric



Farm home of Nels Bach, on Lower Yellowstone Irrigation District.

Cooperative at Finley, Burke-Divide Electric Cooperative at Crosby, Oliver-Mercer Electric Cooperative at Hazen, West Plains Electric Cooperative at Dickinson, Mountrail Electric Cooperative at Stanley and McLean Electric Cooperative at Garrison.

These brought to eighteen the number of REA-financed systems in operation in the state. Cooperative operating systems prior to this time were the Baker Electric Cooperative at Cando, Cass County Electric Cooperative at Kindred, Tri-County Electric Cooperative at Carrington, Verendrye Electric Cooperative at Velva, Nodak Rural Electric Cooperative at Grand Forks, R. S. R. Electric Cooperative at Milnor, North Central Electric Cooperative at Bottineau and the Minnkota Power Cooperative, a generating and transmission cooperative at Grand Forks.

Before the end of the year, four more distributing cooperatives will send energy through their lines for the first time. These are the Kem Electric Cooperative at Linton, Slope Electric Cooperative at New England, Capital Electric Cooperative at Bismarck and the Cavalier Rural Electric Cooperative at Langdon.

The acceleration of the REA program in North Dakota started about 1944. It stemmed from three principal factors:

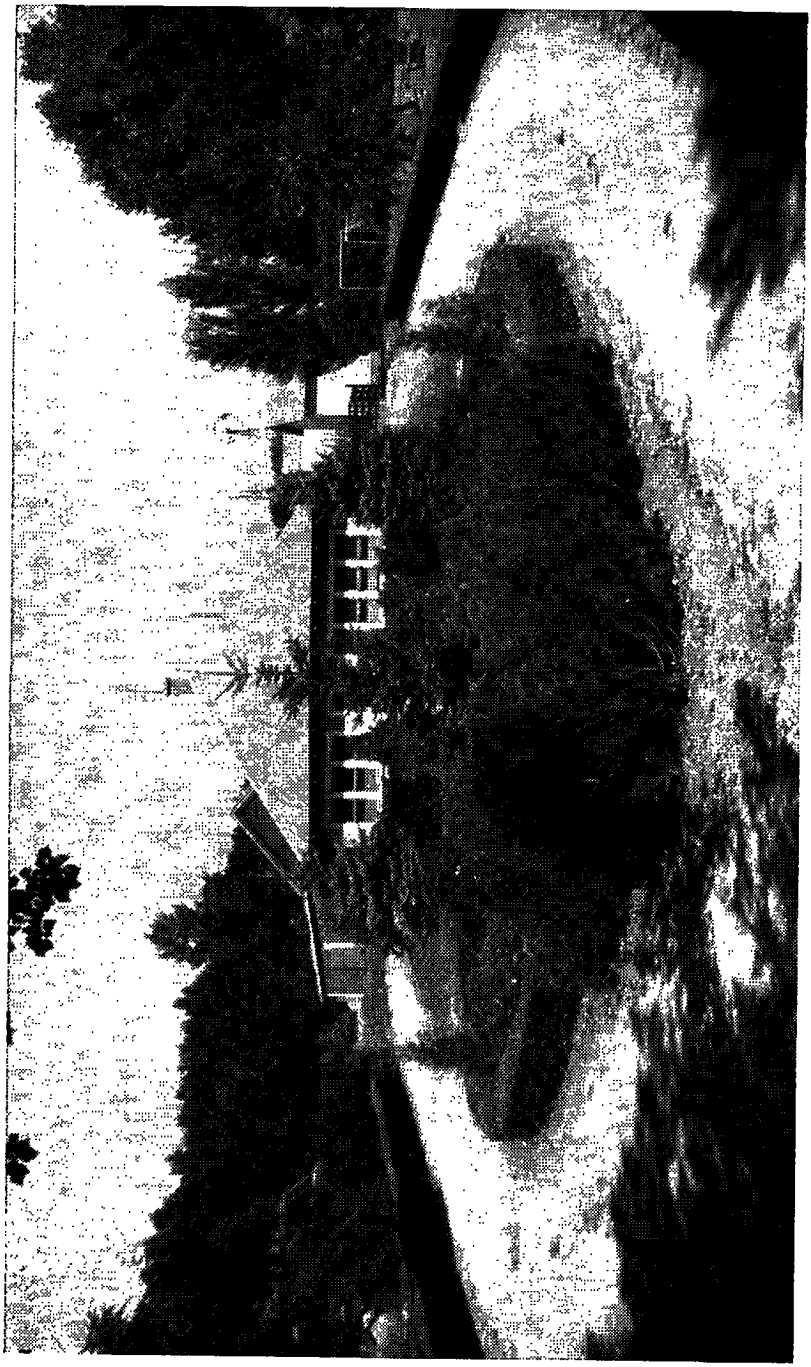
First, in 1944 a policy aimed at applying area-wide electrification to all sections of the country was initiated on an aggressive scale.

Second, more favorable financing terms were made available to borrowers and prospective borrowers of REA funds. The interest rate on loans was reduced to a flat 2 per cent and the period of amortization was extended from 25 to a maximum of 35 years.

Third, out of almost ten years of rural electrification came experience that pointed the way for bringing service to the less densely settled areas on a feasible basis.

The average monthly farm consumption of electricity on REA-financed lines in North Dakota increased from 81 kwh in December, 1941, to 168 kwh in December, 1946 and to 187 kwh in December, 1947. Nationally, this increase was from 61 kwh in December 1941 to 117 kwh in December, 1947. The North Dakota increase is the more remarkable because it is more diluted with new consumers than the national figure.

In 1935, at the start of the REA program, only 1,968 farms, or 2.3 per cent of all farms in the state were electrified. On June 30, 1946, REA estimated that 8,601 or 12.4 per cent were electrified, and on December 31, 1947, it was estimated by the commercial power companies that 12,200 or 17.5 per cent were receiving service.



Farm home of Axel Danielson, on Lower Yellowstone Irrigation District.

STATE GAME AND FISH DEPARTMENT

Water is of paramount interest in the state of North Dakota, not only to the Game and Fish Department but also to the entire state. The great impoundment program now being undertaken by the Bureau of Reclamation and the Army engineers is proof of this fact.

Those of us primarily interested in the wildlife resources of the state have long appreciated water's importance and the importance of keeping certain areas open to the public that they may use them for recreational purposes.

North Dakota is following the pattern of many of the older states, in that many of the best public waterfowl shooting grounds are being purchased by individuals for their private recreation and hunting. Realizing that the great majority of the people are not financially in a position to buy land for hunting and relaxation alone and that the Game and Fish Department is the agency which should protect their interests and provide for their future along these lines, we have resolved to acquire areas which will combine hunting and fishing and recreational places for our people who, for the most part, are far from natural lakes and streams.

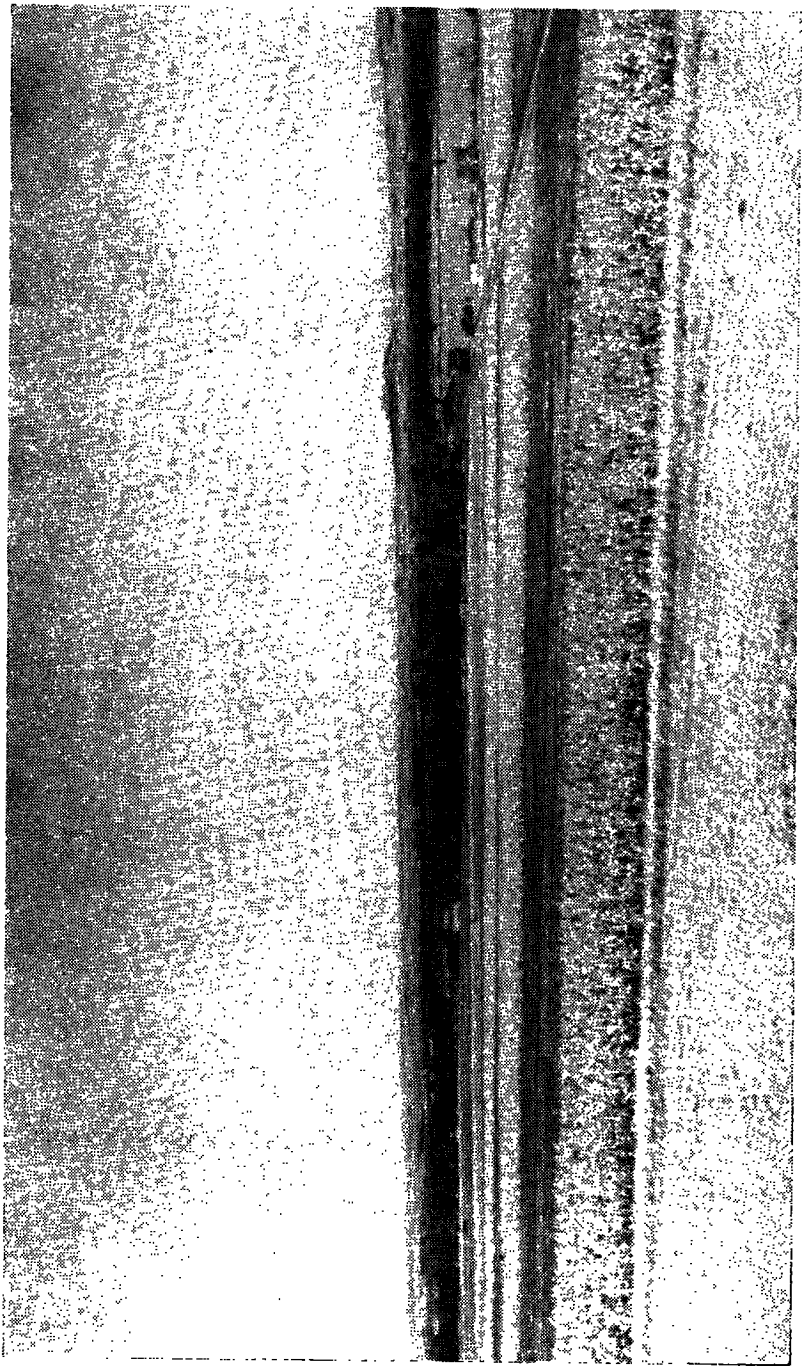
The State Water Conservation Commission is very cooperative in working with the Game and Fish Department in dam construction and water impoundment as well as dam repair. The combined efforts of the two departments will make the life of many a farm community in the more arid parts of North Dakota, a happier and better life because of this program.

We contemplate carrying on this work at an increased tempo and will, in the near future, ask the State Water Conservation Commission for more help than we have in the past. The following figure will, however, give you an idea of what they have cooperated in during the last half of 1947 and the early part of 1948.

State Game and Fish Department share in dam construction in cooperative agreement with State Water Commission for the present biennium, 1947-49. Information gathered from payment vouchers as indicated and shown in the State Water Conservation Commission report. (See Maintenance of Dams).

STATE GAME & FISH DEPARTMENT

H. R. Morgan, Commissioner.



Wogansport Unit of Missouri River Pumping Projects, located about 14 miles north of Bismarck, N. D.

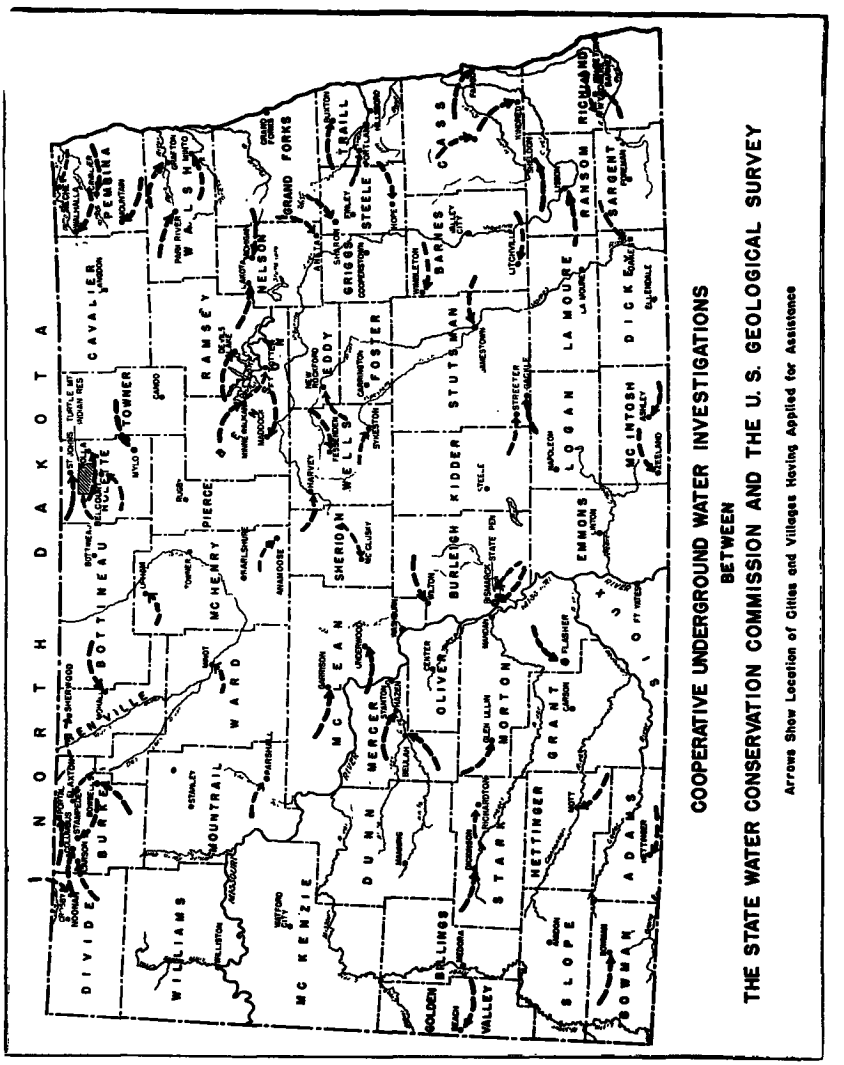
U. S. FISH AND WILDLIFE SERVICE

The Fish and Wildlife Service is the federal custodian of the nation's vast fish and wildlife resources, and in cooperation with the various states, federal agencies, organizations and individuals, has the responsibility of managing this valuable natural asset.

These resources are divided into two major divisions. The fish supplies of our salt water coastal areas, fresh water lakes and rivers of the interior, and the birds and mammals of our forests, farms, marshes and desert country.

The Fish and Wildlife Service program involves a wide variety of activities. Among more important of these are the construction and development of wildlife refuges, fish cultural stations and fish hatcheries, rearing ponds, stream and lake improvement, cover development, range vegetation management, marsh conditioning, the biological study of existing and potential water utilization projects and their effect on fish and wildlife. In the State of North Dakota, the Fish and Wildlife Service now administers and maintains six major national wildlife refuges of primary importance for migratory waterfowl, one big-game refuge, one fish hatchery station and 68 easement refuges, which are distributed as sanctuaries for waterfowl and other forms of wildlife.

The 112,000 acre-foot Lake Darling Reservoir on the Souris River (Mouse) above Minot is the largest impoundment maintained by the Service in the state. It has served admirably as a flood control reservoir in the years of excessive spring runoff for the Souris river watershed. Since the date of its construction in 1935, the Lake Darling Reservoir has alleviated a number of very serious flood threats to the city of Minot and to the river valley below the dam. The most serious flood condition occurred in April and May of 1948, and had it not been for the flood control practices carried out by the Fish and Wildlife Service in cooperation with the North Dakota State Water Conservation Commission, an appalling amount of damage would have occurred in Minot and along the lower reaches of the Souris. The State Water Conservation Commission and the Fish and Wildlife Service cooperate here in flood control regulation and in regulating the amount of water released for irrigation and stream pollution, and for release to Canada under orders of the International Joint Commission, since the Souris River is an international stream. In the above described management and regulation of Souris River waters under the direction of the International Joint Commission, the North Dakota State Water Conservation Commission, United States Geological Survey and United States Fish and Wildlife Service all cooperate in maintaining stream flow discharge and water storage records within the Souris River and its tributary watershed drainage basin so that the water may be regulated for the benefit of the towns, cities, rural districts, federal refuges, organizations and property owners lying within the watershed.



COOPERATIVE UNDERGROUND WATER INVESTIGATIONS
BETWEEN
THE STATE WATER CONSERVATION COMMISSION AND THE U. S. GEOLOGICAL SURVEY

Arrows Show Location of Cities and Villages Having Applied for Assistance

REPORT OF THE STATE GEOLOGIST

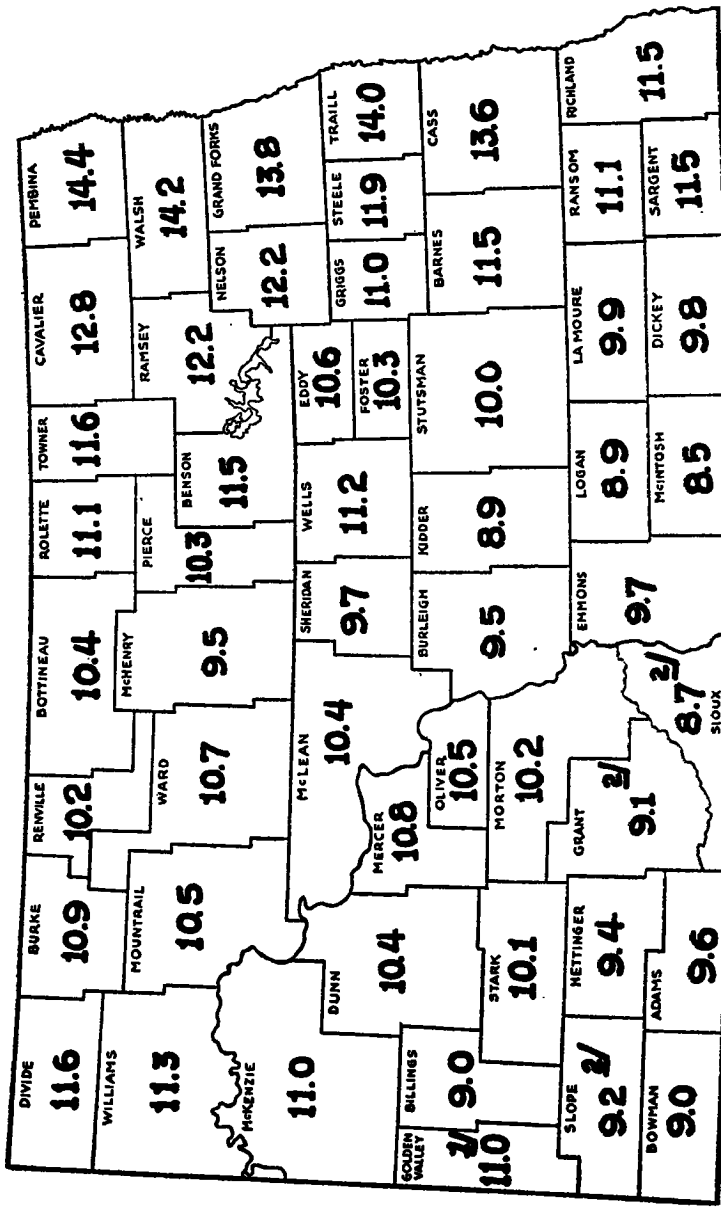
Dr. Wilson M. Laird

The underground water program of the State Water Conservation Commission has been carried on in cooperation with the Ground Water Division of the United States Geological Survey under the supervision of the State Geologist who acts as technical advisor for the Water Commission on such matters.

The underground water work in North Dakota consists of several main divisions. The first of these is the observation well program. This program has been carried on for many years and a considerable fund of very valuable information has been built up. At the end of 1947 water levels were being measured in 154 wells in the state. Of these, ten had automatic water stage recorders which record the changes in water level automatically twenty-four hours a day. Twenty-two of this number were measured weekly by local observers who were paid a small amount for this service. The remainder of the wells are measured at least twice a year by one of our temporary employees. We plan to measure all observation wells at least twice a year, and more often if possible. It would be desirable if our observation well program could be expanded, inasmuch as this type of data apparently is much in demand by governmental agencies, particularly those interested in the water development of the state.

By far the largest amount of work that is being done by our cooperative program at the present time deals with municipal supplies. Two reports have been finished during the past year. These are Cass County, North Dakota, and Clay County, Minnesota, report which is being mimeographed at the present time and should be ready soon for distribution, The other is the Wimbledon report which has been finished and should be ready for distribution soon.

At the present time we have studies in progress in the following cities: Devils Lake, Kindred, Lakota, Litchville, Maddock, Michigan, Minnewaukan, Mohall, Neche, Portland, Rolla and Wyndmere. Of these the reports on the Kindred, Litchville, Maddock, Michigan, Minnewaukan, Portland and Wyndmere areas should be ready in the near future. It has been our policy to do as much work in the field as possible during the relatively limited field season available in North Dakota and when it is impossible to work in the field the reports are prepared. As a result, we are somewhat behind in the writing of our reports due to the large number of studies we have underway. However, all pertinent information which is of use to the cities has been given to them in conferences and all such information is available in an open file in our office for perusal of interested parties at any time. It might be stated that this information is much in demand by consulting engineers who are working on water supply problems for these municipalities.



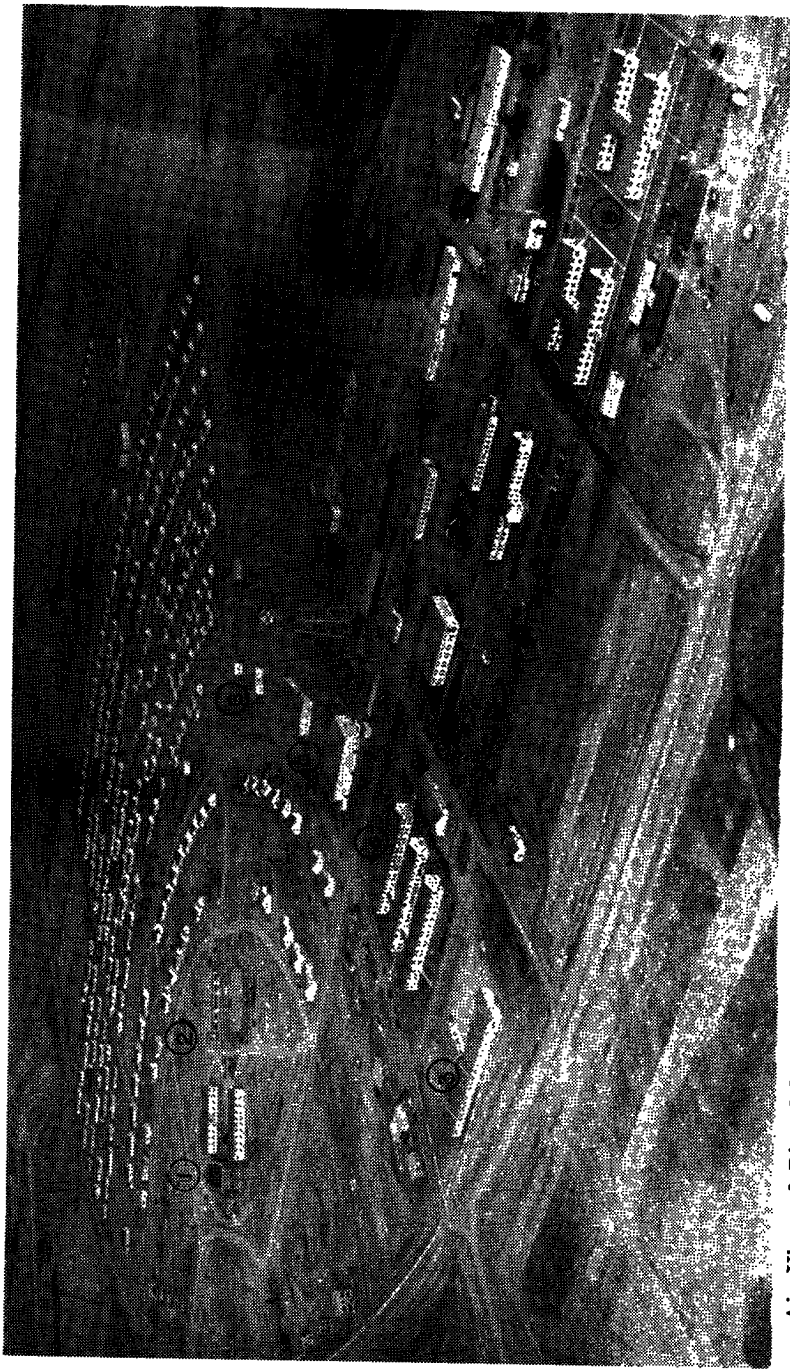
Average Wheat Yields by Counties for 35 Years as Compiled by Dean Walster

In connection with our municipal work, we are also carrying on regional studies. It so happens that a number of the towns have been fairly closely spaced so that we have a fairly large body of information built up about several broad areas in the state, notably Benson and Wells counties as well as in Cass county. This information is useful not only to the municipalities but also to farmers and others interested in water supplies in the vicinity. In any municipal study it is necessary to study considerable areas so that we can say as nearly as possible that water does not exist within a given distance of the town interested.

In all our ground work, test drilling with the state-owned drilling machine is an important factor. During the past year we drilled 147 holes for a total footage of 17,286 feet. These holes ran in depth from 19 feet to 570 feet. Without test drilling our program would be much less effective. The state-owned drilling rig has been a valuable accession to our equipment and the work would be very badly handicapped were it not available. The rig is used in obtaining samples of the underground water-bearing formations to see if water is present. All of these samples have been saved and are on file for further study by anyone concerned, in the offices of the North Dakota Geological Survey at Grand Forks.

As far as our work for the future is concerned, it would seem that the best thing is to continue our municipal studies as they are needed and also expand our regional attack on underground water problems. As far as regional work is concerned, we should concentrate not only on possible municipal supplies in a given area, but also to find out information concerning supplies that can be used by farmers and stock raisers in the immediate area. Furthermore, there is great interest in certain localities at the present time in determining the possibility of obtaining underground water supplies for irrigation. We have a number of areas in the state which have been located in our investigations where underground water might be profitably used for irrigation.

We should as soon as possible institute a study of the waters of the Dakota sandstone which underlies much of the state. Such a study was carried on in a small way several years ago by both the State Geological Survey and the Federal Geological Survey. The area covered in this report only included the Ellendale-Jamestown area. This study should be carried on with the view of making recommendations to the well owners as to proper conservation procedures. At the present time a number of these wells are being allowed to flow in such fashion that not only is it ruining good land on which this rather salty artesian water flows, but it is also diminishing the artesian pressure so that some wells which formerly flowed no longer do so. It woud be wise if a complete underground water study of this formation were made so that recommendations as to conservation of this very valuable natural resource might be made.



Air View of Riverdale, Nov., 1948. 1—New Administration Building. 2—Store Buildings. 3—Hospital. 4—Hotels, 5—Theatre. 6—School. 7—Temporary Administration. 8—Workmen's Barracks.

UNDERGROUND WATER SURVEYS REQUESTED

List of municipal water supplies, investigation completed:

Aneta	Beulah	Buxton	Dickinson
Cavalier	Fargo-Moorhead	Hope	Kindred
Maddock	Michigan	Minnewaukan	Minot
Mountain	Oakes	Wimbledon	Wyndmere
Zeeland	Fessenden	New Rockford	Sharon

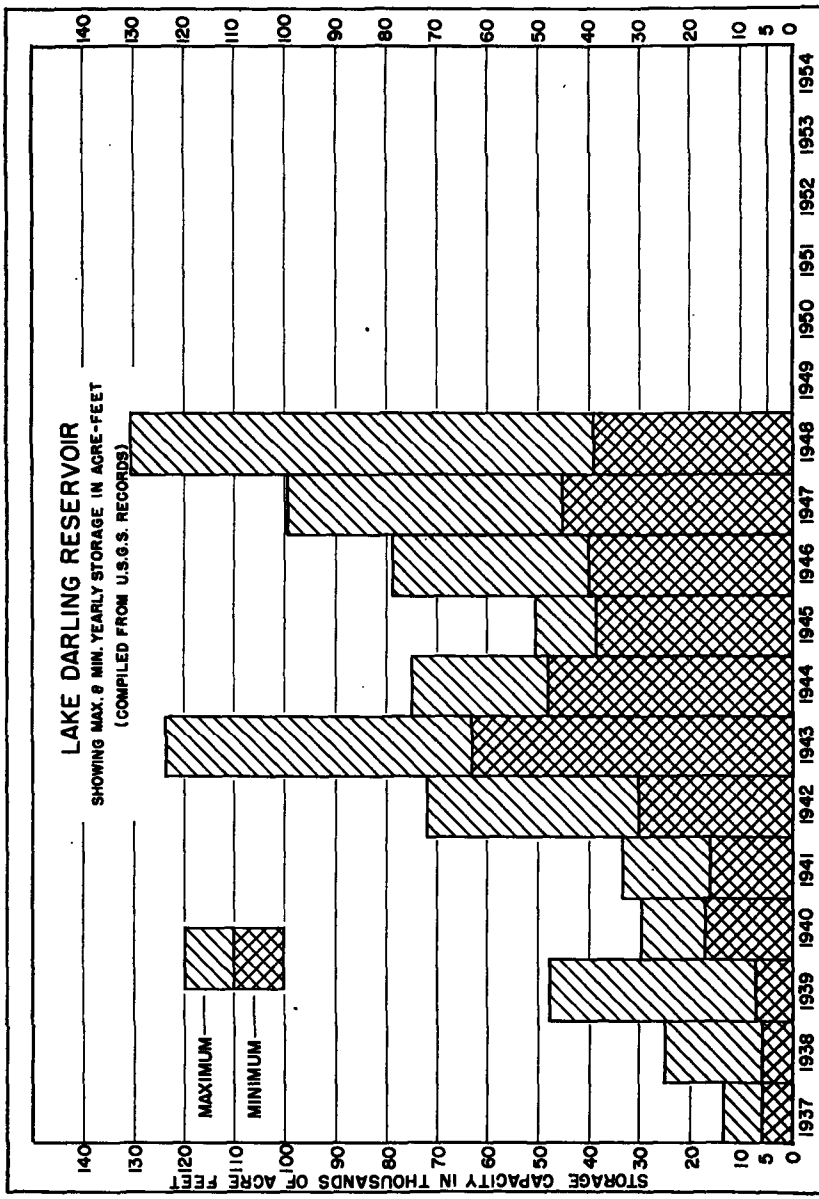
List of investigations started:

Anamoose	Bowman	Devils Lake	Flaxton
Litchville	Mohall		

List of other investigations requested:

Ashley	Wyndmere	Belfield	Beach
Belcourt	Barney	Bowbells	Flasher
Fort Totten	Casselton	Columbus	Garrison
Grafton	Gackle	Glen Ullin	Hazen
Hettinger	Grand Forks	Harvey	Lakota
Lisbon	Jamestown	Karlsruhe	Mylo
Neche	McClusky	Minto	Parshall
Portal	Noonan	Park River	Rolla
St. John	Portland	Richardton	Stampede
State	Sheldon	Sherwood	Underwood
Penitentiary	Streeter	Sykeston	Wimbledon
Upham	Walhalla	Wilton	

The underground water studies are under the direction of Wilson M. Laird, Ph. D., State Geologist. P. E. Dennis, M. A. Geologist in charge with eleven assistants and drillers are the U. S. Geological Survey crew.



Flood Control and Game Preserve Lake Water Levels Variation
Reservoir Behind Dam Above Minot on Souris (Or Mouse) River

STATE HEALTH DEPARTMENT

Problems of mutual concern to the State Department of Health and the Water Conservation Commission are normally handled through the cooperative efforts of the Division of Sanitary Engineering and the Commission. During the biennium the Division of Sanitary Engineering, State Department of Health, has reviewed 152 final and 53 preliminary plans and specifications for proposed water supply systems, sewerage works and extensions of such systems. The total value on which final plans have been approved during the biennium is estimated to be $10,000,000 and preliminary plans on an additional $7,000,000 worth of works has been reviewed. The division has also reviewed preliminary plans for large scale sewerage disposal of what is essentially industrial wastes. Plans have been received and reviewed for improved sewage treatment at Grand Forks and for sugar beet wastes at Fargo-Moorhead. Final plans were also reviewed and approved for a lagoon type of waste disposal at the horse packing plant in Jamestown.

Stream pollution studies were continued on the Souris River and extended to the James River. Some studies have also been made of the sewage strength at one packing industry and two towns having a heavy load of industrial sewage. Most of the flow data on the streams has been secured from data collected by the U. S. Geological Survey.

Chemical analysis of water taken from test wells drilled by the U. S. Geological Survey have largely been done by the State Health Department Chemical Laboratory. This cooperative venture is gradually making available a very complete picture of North Dakota's underground resources.

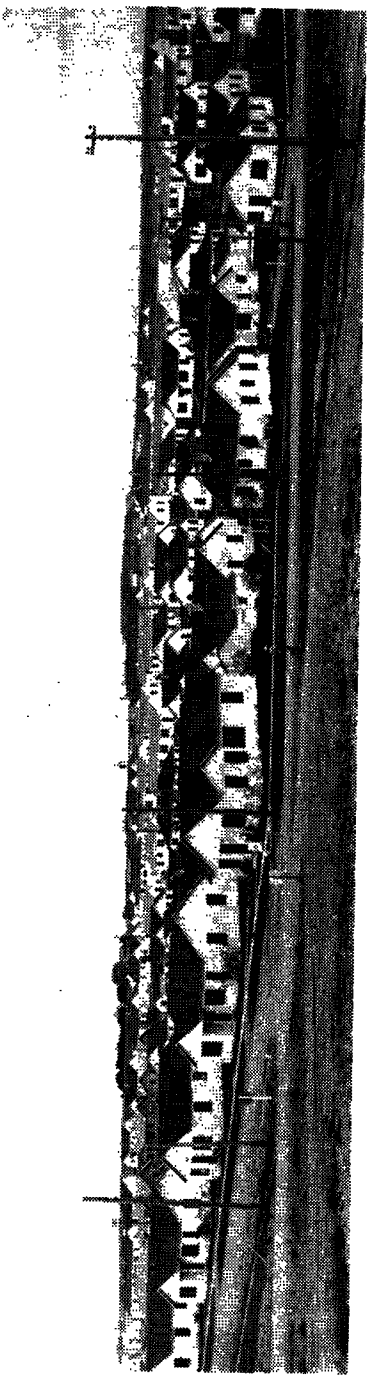
The Division of Sanitary Engineering has provided technical assistance in studies concerning the use and disposal of surface water supplies. Technical advice offered was mainly on how impounding water in several of the federally sponsored reservoirs would affect municipal water supply, recreation, and dilution of sewage discharged downstream.

AGRICULTURAL COLLEGE

The vast Missouri river development program will have a tremendous effect on North Dakota agriculture and materially alter the role of the North Dakota Agricultural College, in the opinion of Dean H. L. Walster. He stated that both irrigation and dam building phases of the project will affect the work of the College because of the tremendous changes which will be brought about in North Dakota agriculture, and in the social and economic status of the people of the state.

It is estimated that the Garrison dam and hydroelectric plant will probably be able to furnish power over the whole state in about seven years, which will bring electricity to most farms at low rates in addition to the present city users and should bring additional industries.

All these developments will call for much research at the college, such as the use of irrigation on glacial soil, marketing of intensive farming products and other activities.



Views of the City of Riverdale, Garrison dam construction town

A plan for an educational campaign reaching into every county, by the county agents, with assistance from the state leaders and others, will bring to the people more of a realization of the great changes and the increased security for agriculture and stock-raising as a result from the planned water utilization. The long-range program will endeavor to conserve and improve the lands, build up and protect forest resources, enlarge and improve agriculture by irrigation and drainage, stabilize and improve farm income, reduce flood and sediment damage and enhance recreation and wild life.

THE LONG WASTED RESOURCE

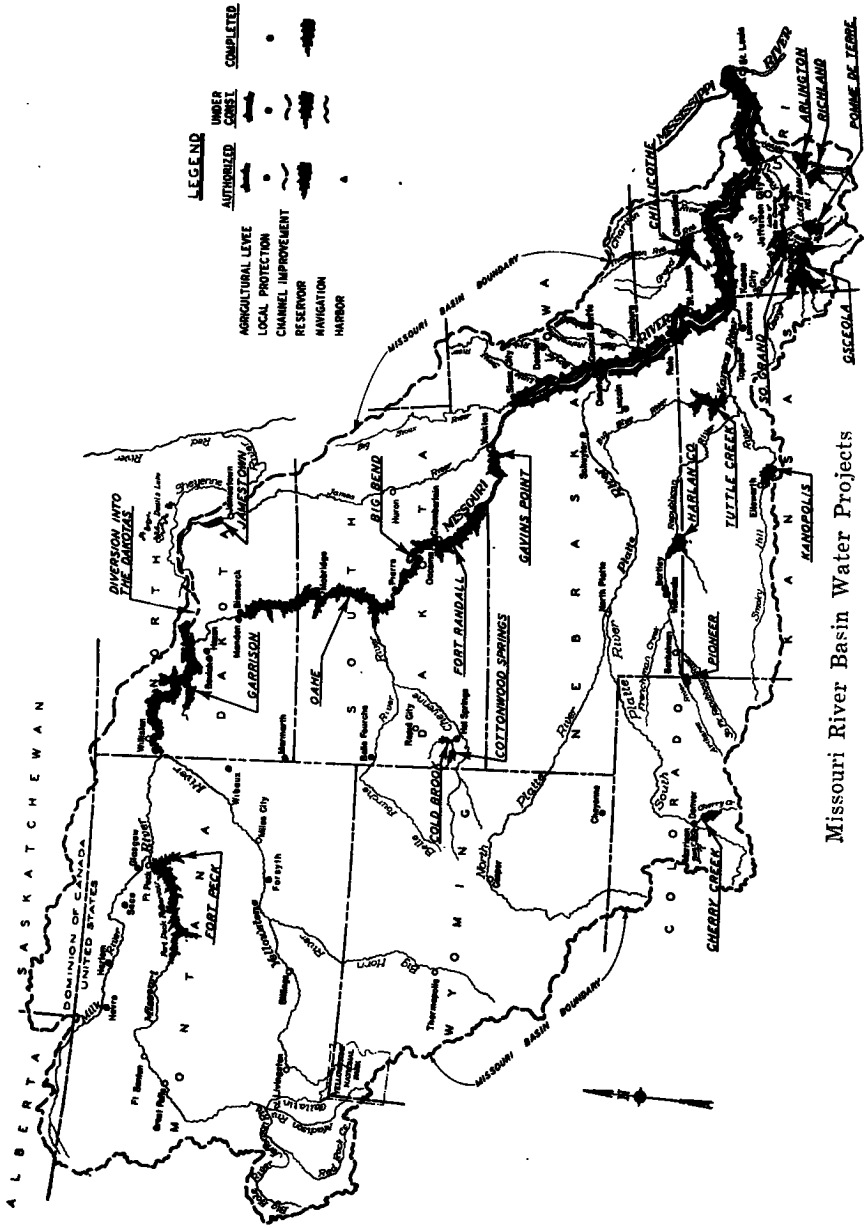
(By Dean H. L. Walster, in May-June, 1948, Bimonthly Bulletin of N. D. Experiment Station)

The Resource of All Resources—our Rivers and Lakes—features which give distinctive character to our landscapes have been about the last to be considered a conservable resource. Rivers, of course, must ultimately run to the sea but on their way they may cause damage, run idly, or do useful work.

The Multiple Use of River Basin Water

The idea of treating the water supply of a river basin as a resource capable of multiple uses is essentially a conservation idea. When worked out in its entirety it must involve the handling of the basin lands upon which precipitation falls as well as the handling of the waters in the stream—the one cannot be separated from the other. The relative emphasis upon the several factors affecting the use of the land and use of the stream may be quite different in different river basins but the fundamental principles will remain the same.

Conservation of river water of the main streams always begins with the mountains and the foothils whose cover of forest and grass act as the first retardant to the downstream progress of the river basin's water supply. Proper management, especially that of the forest, will do much to maintain a reserve supply of snow. Grassland management in the forest and beyond the forest into the plains will provide for further infiltration of water into the soil. Agriculturally occupied and cultivated lands must not be neglected for they are one of the sources of the silt and mud reaching our rivers. It is unfair and unrealistic however, to assume for example that all of the mud and silt load carried by the Missouri River is derived from erosion of tilled lands. The enormous load of silt discharged into the Missouri River by the Yellowstone River is derived in part from thinly-clad, or almost desert areas of much of Wyoming, where the precipitation is insufficient to support a greater soil cover, and where precipitation is frequently torrential in character. Both upstream land management and stream management through the use of siltation dams must be used to the maximum to insure clearer waters for downstream use.



Missouri River Basin Water Projects

Once water gets into the stream the work of stream management begins—this include diversion of some of the water for irrigation; storage in great reservoirs behind dams for a source of irrigation water for flood control, for power, and for navigation control; for municipal use including domestic water supplies and sewage dilution.

The conservation of ourselves and of our physical resources will make a large contribution to our survival as a nation.

BANK OF NORTH DAKOTA

This state-owned bank acts as Trustee for all the issues of bonds of the State Water Conservation Commission, to aid in securing funds for the construction and development of irrigation, and thus to aid landowners in producing larger yields and increasing their income.

The best of cooperation has been given by the officials of the Bank on all the transactions it has handled for the Water Commission. It is carrying the $63,000 unpaid balance on outstanding bonds, but has collected more than $40,000, to be used in payment of bonds or interest as payments become due, and has collateral bonds to cover the balance.

GREATER NORTH DAKOTA ASSOCIATION

One of the greatest forces working for the betterment of all of the people of North Dakota, is the Greater North Dakota Association. Its officials have always been ready to give this Commission any assistance requested for the betterment of the state as a whole. It recognizes that income from stock must be the foundation of agriculture and that the western two-thirds of the state must have irrigation to raise feed for that stock on drouth years, or suffer great losses and the steady income necessary to pay running expenses.

Its accumulation of movie pictures of scenes along the routes of the water development program in North Dakota and the showings of same made in many gatherings of the people of the state has been a great contribution to the educational program as to what this great construction program will mean to the future of North Dakota.

THE FARMERS UNION

The officers of this organization had cooperated in the distribution of information to its leaders and members regarding diversion of the Missouri and development of irrigation districts. They recognize the necessity of farmers having ample feed every year to sustain their livestock, and that irrigation is necessary to secure feed in drouth years, also that it will greatly increase the yields every year. The aim is to have ample feed within easy trucking distance of every farmer in the state. Members of the Farmers Union, through its president Glenn J. Talbott, have given outstanding service in promoting the development of the state's natural resources.

Irrigated alfalfa on the Clayton Worst farm in McKenzie County, North Dakota, yielded five tons to the acre.

COMPACTS

TRI-STATE WATERS COMMISSION

This compact was made and entered into between the states of South Dakota, North Dakota and Minnesota in June 1937, and consented to by an Act of Congress, approved April 2, 1938.

The compact includes the drainage area of the Red River of the North drainage basin in the United States and excludes the Otter Tail river and its tributaries.

Articles of Incorporation give the Commission powers, duties, and jurisdiction to maintain and control lake levels, stream flow and boundary waters, in cooperation with state, federal and municipal agencies, studies and surveys for construction, maintenance and operation of water problems within the scope of its jurisdiction.

The Articles of the Compact provide that the Tri-State Waters Commission shall consist of nine members, three from each state, appointed by each state in such manner, and for such length of term as may be determined by the Legislature thereof. Each commissioner shall be a citizen of the state from which he is appointed, and at least one commissioner from each state shall be a resident of the drainage area of the Red River of the North. The members of the Commission from North Dakota, as of November 1, 1948, consists of Governor Fred G. Aandahl, H. G. Homme, Grafton, and Dean H. L. Walster, North Dakota Agricultural College, its chairman. Members from Minnesota include F. F. Moore, Wheaton; Carsten Mead, Red Lake Falls; and Chester S. Wilson, Commissioner of the Department of Conservation, St. Paul. Members from South Dakota include Sigurd Anderson, Attorney General, Pierre; Elmer Peterson, Director of Game & Fish, Pierre; and D. W. Loucks, State Engineer, Pierre.

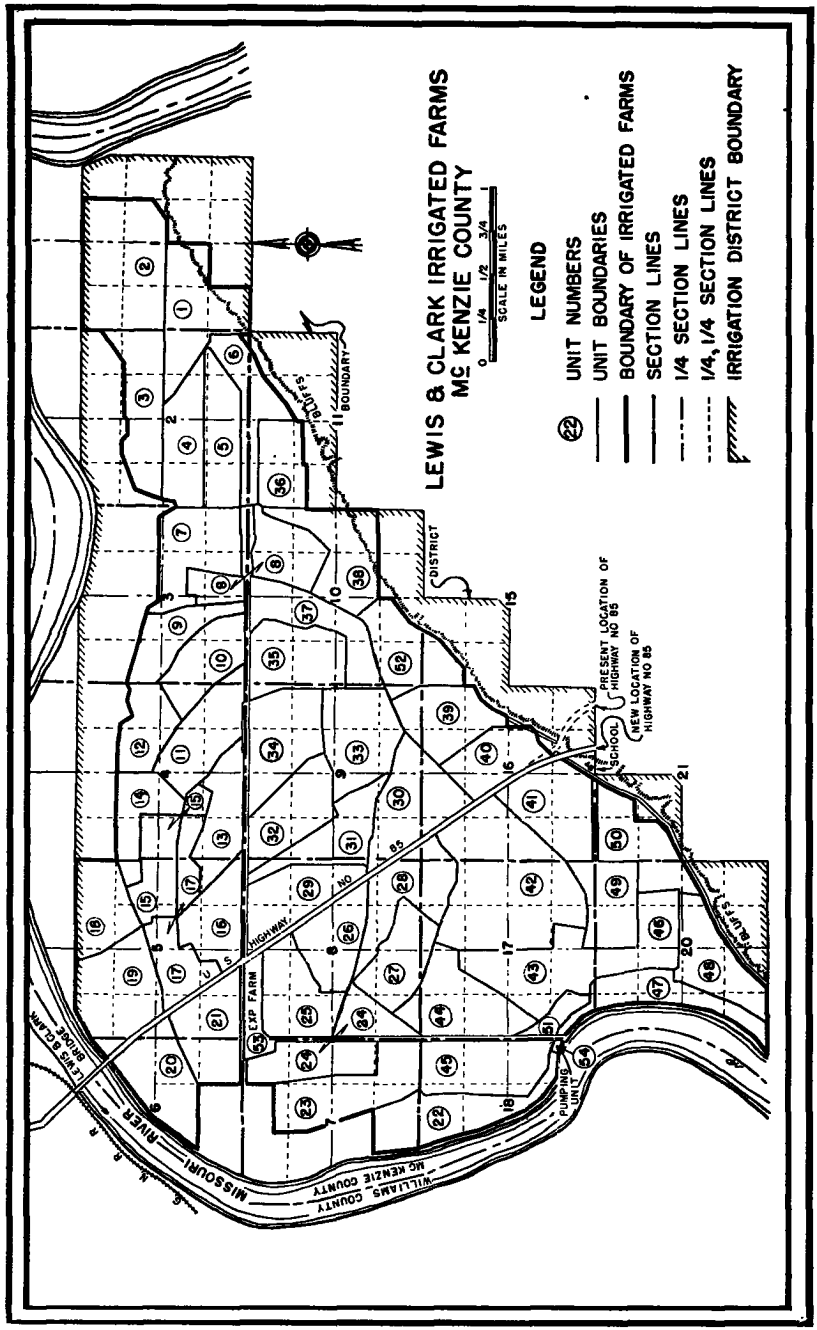
LAKE TRAVERSE AND BOIS DE SIOUX RIVER

Projects completed and in operation include Lake Traverse and the Bois de Sioux river. These projects were completed in 1941. Their principal problem is flood control and regulation of flows,

RED RIVER

The Congress has also made appropriations to the Corps of Engineers for river and channel improvements on the Sheyenne, Rush, and Red rivers of North Dakota. Construction surveys and plans are being prepared by the Corps of Engineers, and it is planned that construction work will commence early in 1949 on these projects.

Division and allocation of the waters of the Red River basin are now under study by the joint engineering committee of the International Joint Commission. It is expected that this Commission will make its final report and adjudication of the waters within the near future.


LEWIS & CLARK IRRIGATED FARMS
Mc KENZIE COUNTY
SCALE IN MILES
0 1/4 1/2 3/4 1
LEGEND
UNIT NUMBERS
UNIT BOUNDARIES
BOUNDARY OF IRRIGATED FARMS
SECTION LINES
1/4 SECTION LINES
1/4, 1/4 SECTION LINES
IRRIGATION DISTRICT BOUNDARY
DISTRICT BOUNDARY
PRESENT LOCATION OF HIGHWAY NO 85
NEW LOCATION OF HIGHWAY NO 85
SCHOOL
EXP FARM
HIGHWAY NO 85
PUMPING UNIT
MISSOURI RIVER
WILLIAMS COUNTY
MC KENZIE COUNTY
LEWIS & CLARK BRIDGE

SOURIS RIVER

The adjudication and division of waters between the provinces of Saskatchewan and Manitoba, Canada, and the State of North Dakota, in the United States, is under the control of the International Joint Commission, composed of three members from the governments of the United States and Canada.

Previous studies and investigations were made and a report issued in 1940, covering the recommendations for the operation and regulation of the flow of the waters of the Souris (Mouse) river. In the report of the Commission, they recommended the continuation of the investigation pending settlement of questions as to the use of the waters of the Souris river. The Commission also recommended that the Province of Saskatchewan and the State of North Dakota be permitted to continue its present use of the waters of the Souris (Mouse) river, and shall remain in effect unless subsequently qualified or modified by the Commission.

During 1948, the Commission authorized the joint board of engineers to continue further investigations and studies of the uses of water from the Souris and Red rivers in North Dakota. Meetings have been held in Winnipeg, Canada, and Minot, North Dakota, by the engineering committee. It is anticipated that further studies will be required before the report is submitted to the International Joint Commission for approval.

YELLOWSTONE RIVER COMPACT

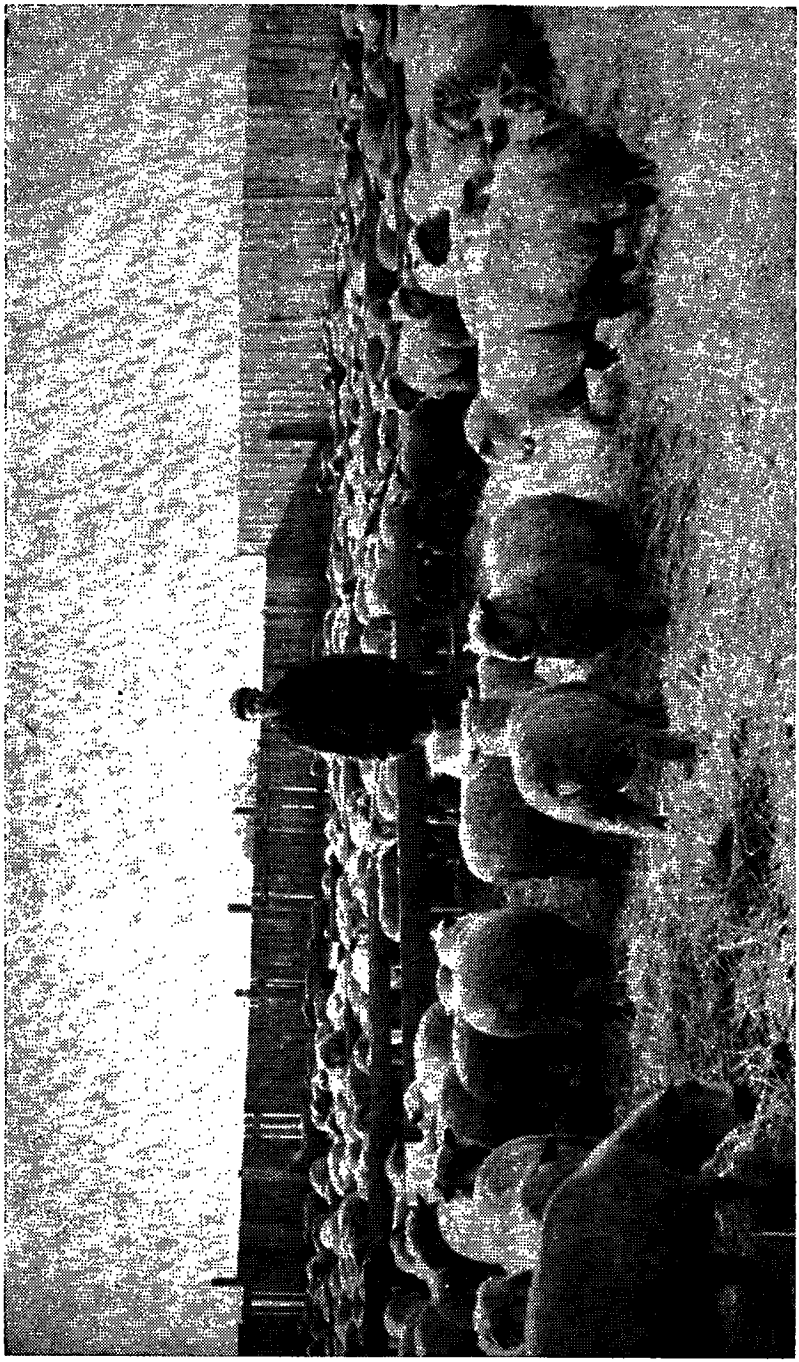
The 1945 North Dakota legislative session passed an act to ratify and approve the Yellowstone River compact between the states of Montana, North Dakota and Wyoming. The state of Montana's 1945 legislative session approved this compact. The Wyoming legislature also approved the compact during the 1945 legislative session, but the measure was vetoed by their Governor.

LITTLE MISSOURI RIVER

Congress has approved the forming of a compact for the division and uses of water from the Little Missouri river in the states of Wyoming, Montana and North Dakota. Further action has been delayed pending more detailed surveys on the amount of land suitable for irrigation and the amount of water available for irrigation purposes. It is anticipated that a compact will be approved by the states involved after the completion of the surveys and reports have been submitted.

GRAND RIVER

The Grand River is an interstate stream located in the southwest section of North Dakota, with headwaters in Bowman County and flowing in a southeasterly direction into South Dakota. In 1904 the U. S.



Feeder lambs, on the George Haffner farm, on Lower Yellowstone Irrigation Project.

Reclamation Service investigated the Bowman Irrigation project. Since that time, the State Engineer of North Dakota, the U. S. Reclamation Service, and the Corps of Army Engineers have made several surveys covering the proposed Bowman project. The plan calls for the construction of a dam to store flood waters for irrigating approximately 5,000 acres of land. Before any dam is constructed on the Grand River in either state, there should be a compact or agreement between the states of South Dakota and North Dakota.

JAMES RIVER

The James river has its source in eastern North Dakota and flows southerly through North Dakota and across South Dakota, entering the Missouri river below Yankton, South Dakota.

James river is an interstate stream in which major floods have occurred, causing great damage. At periods, the small stream flow does not provide sufficient water for domestic and municipal purposes to towns and villages along the river in South Dakota and North Dakota.

Under the comprehensive plan for the development of the Missouri River basin, water will be diverted into the headwaters of the James river for domestic use, municipal supplies, irrigation and other purposes.

Compact negotiations should be commenced at as early a date as possible for the allocation of the water by the States of South Dakota and North Dakota, in order that a compact may be approved and ratified before any construction work commences.

BISMARCK IRRIGATED PROJECTS

The original Bismarck Irrigation project, by pumping from the Missouri river, contained an estimated 5,000 acres of river bottom lands south of Bismarck city. It was found by surveys in 1943-4 that by pumping up the water about 25 ft. by another lift that approximately 15,876 acres could be irrigated, partly up the Apple Creek valley. The Bureau of Reclamation engineers made soil and other surveys and estimated that about 10,000 acres in the area are suitable for irrigation, and have it on their list as one of the proposed Missouri river pumping irrigation projects.

An irrigated gardens project of about 55 acres was started as a war Victory Gardens demonstration project, and is being continued with more than two hundred plats operated with considerable success, and urgent request for its continuance.

HEART RIVER IRRIGATION PROJECT

Two areas are being developed by the Bureau of Reclamation engineers, using government appropriations. The Heart Butte dam construction contract was made early in 1948 and construction is pro-

Site of Pumping Plant for Fort Clark Irrigation District, Missouri River

ceeding ahead of a schedule which would complete the dam in 1949. The plan includes the irrigation of about 13,000 acres down the Heart river valley and out on the river bottom lands between Mandan and Bismarck. Appropriation by Congress was made for a connection of an electric high line with the Garrison dam power when available. It is planned to make all of the irrigation as pumping projects to utilize this cheap power.

It is planned to complete a contract for construction of the Dickinson dam during the winter of 1948-9 so that work can begin early in 1949, and the dam completed in 1950. This dam will impound waters for flood control, municipal water supply for the city of Dickinson, and irrigation of about a thousand acres of land by pumping. Holding back flood waters on both of these dams will alleviate flood damage at Mandan.

MISSOURI BASIN INTER-AGENCY COMMITTEE

The Inter-Agency Committee is composed of the Corps of Engineers, Department of the Interior, Department of Agriculture, Federal Power Commission, and the Department of Commerce, and is coordinating the work of developing the Missouri River basin plan as authorized by Congress.

Representing the various federal agencies are Major General Lewis A. Pick, Corps of Enginneirs, and chairman of the committee; W. G. Sloan, Department of the Interior; Gladwin E. Young, Department of Agriculture; B. H. Greene, Federal Power Commission; and William R. Davlin, Department of Commerce.

Membership of the committee also includes Governor Val Peterson of Nebraska, Governor Sam C. Ford of Montana, Governor Fred G. Aandahl of North Dakota, Governor Phil M. Donnelly of Missouri, and Governor L. C. Hunt of Wyoming. They were selected to represent the ten governors of the Missouri River States Committee.

The committee meets monthly, rotating to the different states in the Basin, to discuss state, federal and local problems presented to the Inter-Agency Committee for review and recommendations, and to determine policies and procedure in the carrying out of the Missouri River development plan.

Recently, the committee has worked out a six-year program for the development of the Missouri River basin to extend over a period from 1950 to 1955, inclusive. The program includes the construction and development of all river waters within the Basin for flood control, irrigation, power development, navigation, soil conservation, conservation of fish and wildlife, municipal water supplies and other uses, as outlined and shown in the following tables.

NORTH DAKOTA
SIX-YEAR PROGRAM FOR MISSOURI RIVER BASIN
Prepared by
MISSOURI BASIN INTER-AGENCY COMMITTEE

FEATURE OR PROJECT	ESTIMATED COST Total for Construction	Annual for Continuing Programs	Fund to End of Fiscal Year 1948	1949 Fiscal Year Funds	Total Estimated Cost 6-Year Program 1950-1955	Total Unscheduled Cost & Funds Required After Fiscal Year 1955
STATE OF NORTH DAKOTA						
Agricultural Experiment Station	$	$ 215,500	$ 204,500	$ 205,000	$ 1,529,000	$ .....
Agricultural Extension Work	.....	80,600	6,200	43,900	594,300	.....
Highways	5,932,500	.....	352,500	715,000	6,982,500	.....
Game & Fish	.....	23,800	17,500	22,500	167,500	.....
Water Commission	.....	290,000	285,000	315,400	2,035,400	.....
Soil Conservation	.....	17,600	10,470	10,470	130,470	.....
Department of Agriculture & Labor	.....	95,300	67,717	88,000	671,000	.....
Department of Public Health	.....	.....	.....	1,000	136,000	.....
Research Foundation	.....	12,000	12,000	12,000	84,000	.....
Subtotal—State of N. D.	$ 5,932,500	$ 734,800	$ 955,887	$ 1,413,270	$ 12,330,170	.....
PUBLIC HEALTH SERVICE						
Stream Pollution	$	$ 5,000	.....	$ 1,000	$ 95,200	.....
Mosquito Control	.....	12,000	.....	8,000	78,000	.....
Health and Sanitation in Construction Areas	.....	30,000	.....	23,000	399,000	.....
Special Sanitation Engineering Services	.....	6,000	.....	1,500	52,000	.....
Subtotal—P.H.S.	.....	$ 53,000	.....	$ 33,500	$ 624,200	.....
FEDERAL POWER COMMISSION						
River Basin Surveys	.....	$	$	$	$ 90,000	.....
Power Requirements and Supply Studies	.....	.....	.....	.....	55,000	.....
Licensed Project Works	.....	.....	.....	.....	13,000	.....
Subtotal—F.P.C.	.....	.....	.....	.....	$ 158,000	.....

DEPARTMENT OF COMMERCE						
Coast and Geodetic Survey	$ 270,000	$ ----	$ ----	$ 20,000	$ 250,000	----
Weather Bureau						
Flood Forecasting Service	----	24,000	8,000	8,000	140,000	----
Water Supply Forecast Service	----	3,000	----	----	20,000	----
Hydroclimatic Network	----	8,000	5,000	5,000	40,000	----
Mach. Process. & Analysis Program	----	2,000	2,000	2,000	45,000	----
Weather Bureau						
Supporting Services	----	5,000	2,000	2,000	94,000	----
Economic information, studies and surveys	----	----	18,000	31,000	126,000	----
Subtotal—D. of C.	$ 270,000	$ 42,000	$ 35,000	$ 68,000	$ 715,000	----
CORPS OF ENGINEERS						
Mandan	$ 414,000	$ ----	$ 40,000	$ 334,000	$ 40,000	----
Beulah	95,000	----	8,000	87,000	----	----
Hazen	40,000	----	4,500	35,500	----	----
Garrison Reservoir	177,000,000	----	26,780,000	26,000,000	124,220,000	----
Jamestown Reservoir	12,000,000	----	----	40,000	11,960,000	----
Cannonball River Basin	650,000	----	----	----	----	650,000
Surveys and Reports	350,000	----	92,000	40,000	18,000	200,000
Subtotal—C. of E.	$190,549,000	----	$ 26,924,500	$ 26,536,500	$136,238,000	$ 850,000
DEPARTMENT OF AGRICULTURE						
Forest Service						
Forest and Range Watershed Research	$ ----	$ 54,000	$ 11,700	$ 11,700	$ 279,000	$ ----
Cooperative Tree Planting on State and Private Lands	836,000	----	2,700	2,700	168,000	668,000
Educational and Technical Assistance in Forestry	----	15,500	1,700	1,700	55,500	----
Subtotal	$ 836,000	$ 69,500	$ 16,100	$ 16,100	$ 502,500	$ 668,000
Forest Service and Soil Conservation Service						
Flood Control Surveys	62,000	----	----	62,000	----	----
Flood Control Remedial Measures	73,054,000	----	----	----	12,488,000	60,566,000
Subtotal	$ 73,116,000	$ ----	$ ----	$ 62,000	$ 12,488,000	$ 60,566,000

SIX-YEAR PROGRAM FOR MISSOURI RIVER BASIN—(Continued)

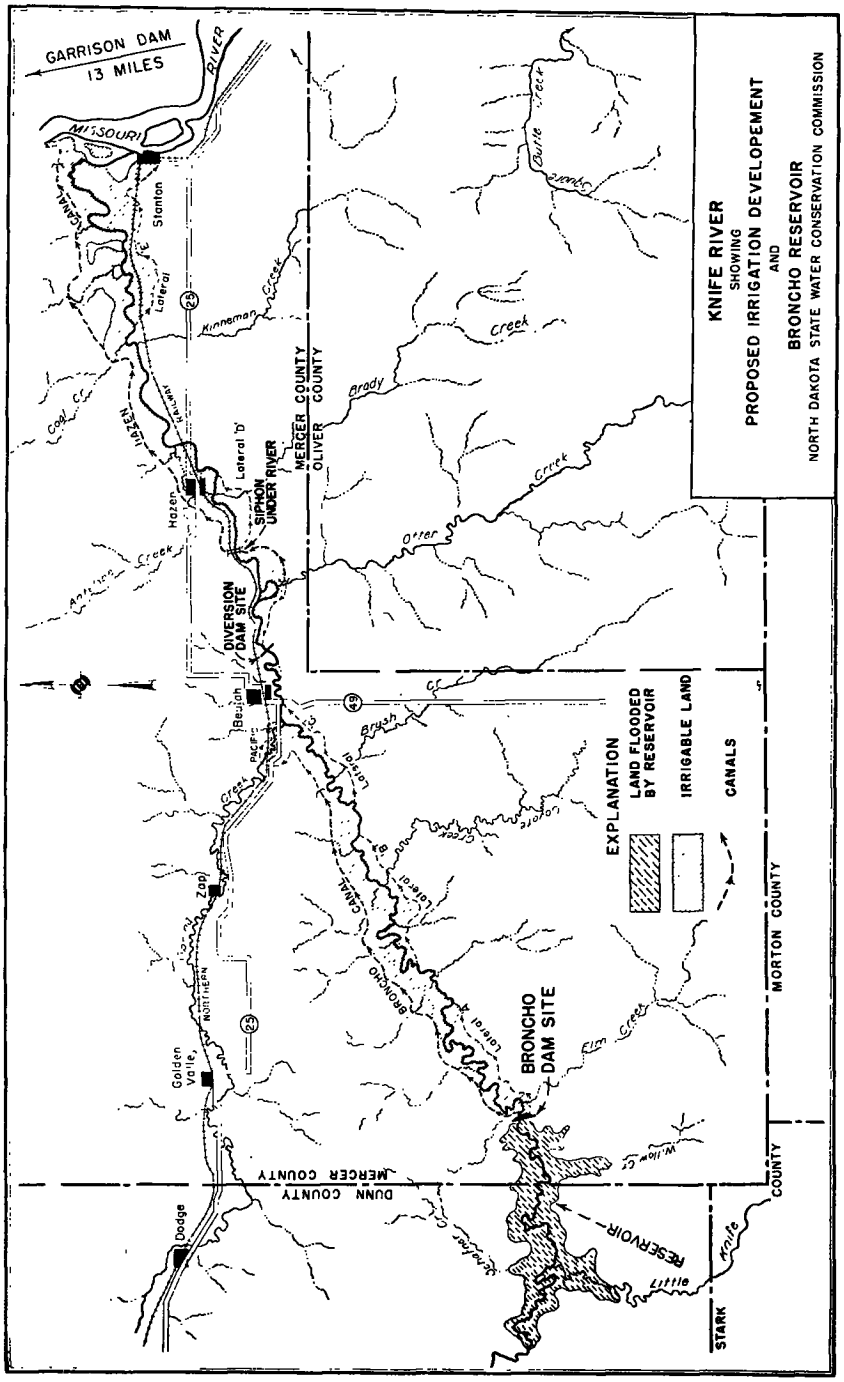
FEATURE OR PROJECT	ESTIMATED COST Total for Construction	Annual for Continuing Programs	Fund to End of Fiscal Year 1948	1949 Fiscal Year Funds	Total Estimated Cost 6-Year Program 1950-1955	Total Unscheduled Cost & Funds Required After Fiscal Year 1955
Soil Conservation Service						
Program of Conservation in Districts	$ 60,708,000	$	$ 624,000	$ 864,000	$ 8,658,000	$ 50,562,000
Technical Service for Irrigation	7,970,000	.....	40,000	40,000	498,000	7,392,000
Research on Conservation Treatment of Land	860,000	.....	7,000	7,000	450,000	410,000
Research on Irrigation and Drainage	926,000	.....	.....	7,000	445,000	481,000
Land Use Adjustment Projects	825,000	.....	45,000	35,000	255,000	480,000
Water Utilization Projects	182,000	.....	32,000	13,000	130,000	7,000
Subtotal	$ 71,471,000	.....	$ 748,000	$ 966,000	$ 10,436,000	$ 59,332,000
Production & Marketing Administration						
Agricultural Conservation Program	.....	$ 12,800,000	$ 5,600,000	$ 2,300,000	$ 75,900,000	.....
Farm Home Administration						
Water Facilities Loans	.....	.....	11,508	14,385	5,253,000	.....
Production and Subsistence Loans	.....	8,411,000	1,090,629	1,363,286	33,396,000	.....
Farm Ownership Loans	.....	3,151,000	967,013	1,208,766	13,640,000	.....
Subtotal	.....	$ 11,562,000	$ 2,069,150	$ 2,586,437	$ 52,289,000	.....
Rural Electrification Administration						
Rural Electrification Loans	.....	.....	$ 13,745,000	$ 23,000,000	$ 19,000,000	.....
Bureau of Plant Industry, Soils & Agri. Engineering						
Basic Soil Survey of Irrigable Areas	294,000	.....	.....	9,000	294,000	.....
Basic Soil Survey of Watershed Lands	1,615,000	.....	.....	.....	407,000	1,208,000
Research in Soil & Crop Management Under Irrigation	.....	85,000	.....	.....	500,000	.....
Subtotal	$ 1,909,000	$ 85,000	$	$ 9,000	$ 1,201,000	$ 1,208,000

Bureau of Agricultural Economics						
Research on Income Potentials of Irrigation Farming		$ 20,000			$ 140,000	
Research on Outlook and Facilities for Marketing		15,000			110,000	
Research on Economic Problems of Irrigation Development		20,000			115,000	
Research on Economic Problems of Watershed Management		10,000			75,000	
Subtotal		$ 65,000			$ 440,000	
Farm Credit Administration						
Study of Loan Experience in Irrigated Areas					$ 3,000	
Agricultural Extension Service						
Edu. Prog. in Watershed Mgt. & Irrig. and Drge. Dev.		78,000			379,250	
Office of Experiment Stations						
Payments to States for Agricultural Research		183,040	122,320	135,520	1,098,240	
Subtotal—D. of A.	$147,332,000	$ 24,842,540	$ 22,300,570	$ 29,075,057	$173,736,990	$121,774,000
DEPARTMENT OF INTERIOR						
Bureau of Reclamation—Region 6						
Cannonball	$ 9,000,000		$ 300,000	$ 680,000	$ 7,920,000	$ 100,000
Heart River	7,593,950		1,329,945	2,356,150	3,905,855	2,000
North Dakota Pumping	15,202,000		180,000	42,500	5,612,700	9,366,800
Minor Western Tributaries	305,700		58,626	10,500	236,574	
Knife River	10,240,000		64,254		8,110,000	2,065,746
Buford Trenton Project	1,267,785		1,121,785	59,305	86,695	
Missouri-Souris	248,633,000		1,070,800	500,000	120,222,000	126,840,200
Subtotal	$292,242,435		$ 4,125,410	$ 3,648,455	$146,093,824	$138,374,746
Bureau of Mines						
Mining Studies		$ 8,000	2,800	10,000	58,000	
Metallurgical Studies		2,000			31,000	
Petroleum Studies		4,000			21,000	
Coal Studies		25,000	1,000	11,000	155,000	
Economics and Statistics		6,000			36,000	
Subtotal		$ 45,000	$ 3,800	$ 21,000	$ 301,000	

SIX-YEAR PROGRAM FOR MISSOURI RIVER BASIN—(Continued)

FEATURE OR PROJECT	ESTIMATED COST Total for Construction	Annual for Continuing Programs	Fund to End of Fiscal Year 1948	1949 Fiscal Year Funds	Total Estimated Cost 6-Year Program 1950-1955	Total Unscheduled Cost & Funds Required After Fiscal Year 1955
Bureau of Indian Affairs						
Activities with B. of R. Program	$ 10,000	.....	.....	750	9,250	.....
Activities with Corps of Engineers program	316,000	.....	122,500	32,500	161,000	.....
Resource Investigation and Development on Indian Reservations	30,000	.....	.....	.....	30,000	.....
Subtotal	$ 356,000	.....	$ 122,500	$ 33,250	$ 200,250	.....
Bureau of Land Management						
Public Land and Resource Inventories & Use Capability Survey & Mineral Examinations	53,500	.....	5,000	15,500	31,000	2,000
Management & Disposition of Public Domain Lands & Resources	74,450	.....	9,150	9,300	51,000	5,000
Conservation, Protection & Development of Public Domain Lands	26,000	.....	.....	.....	21,000	5,000
Cadastral Surveys	815,000	.....	160,500	91,500	563,000	.....
Subtotal	$ 968,950	.....	$ 174,650	$ 116,300	$ 666,000	$ 12,000
Fish and Wildlife Service						
Activities in connection with Bureau of Reclamation Program	$ 212,651	.....	$ 38,851	$ 28,800	$ 145,000	.....
Activities in Connection With C. of E. Program	20,216	.....	1,816	2,400	16,000	.....
Basinwide Surveys	584,900	.....	13,900	20,000	551,000	.....
Federal Refuges	892,186	.....	.....	.....	892,186	.....
Hatcheries	334,800	.....	.....	.....	334,800	.....
Wildlife Research	100,000	.....	.....	.....	100,000	.....
Fishery Research	100,000	.....	.....	.....	100,000	.....
Subtotal	$ 2,244,753	.....	$ 54,567	$ 51,200	$ 2,138,986	.....

U. S. Geological Survey						
Water Investigations						
Surface	.....	93,000	.....	32,000	612,000	.....
Ground	.....	69,000	.....	24,000	459,000	.....
Quality	.....	18,000	.....	7,000	121,000	.....
Sediment	.....	50,000	.....	18,000	336,000	.....
Geologic Mapping and Mineral Investigations	.....	110,000	.....	35,000	720,000	.....
Topographic Mapping	.....	100,000	.....	400,000	1,500,000	.....
River Surveys	.....	.....	.....	58,000	.....	.....
Subtotal	.....	$ 440,000	.....	$ 574,000	$ 3,748,000	.....
National Park Service						
Activities with Bureau of Reclamation Program Planning	$ 68,915	.....	24,775	21,140	23,000	.....
Activities with Bureau of Reclamation Program Construction	92,675	.....	.....	.....	92,675	.....
Activities with Corps of Engineers Program Planning	5,250	.....	2,850	900	1,500	.....
Basinwide Surveys	57,000	.....	.....	.....	57,000	.....
Subtotal	$ 223,840	.....	$ 27,625	$ 22,040	$ 174,175	.....
Smithsonian Institution						
Activities with B. of R. Program	66,673	.....	11,368	660	54,645	.....
Activities with Corps of Engineers Program	438,500	.....	4,870	8,620	425,010	.....
Subtotal	$ 505,173	.....	$ 16,238	$ 9,280	$ 479,655	.....
Subtotal—D. of I.	$296,541,151	$ 485,000	$ 4,524,790	$ 4,475,525	$153,801,890	$138,386,746
GRAND TOTAL—STATE OF NORTH DAKOTA	$640,624,651	$ 26,157,340	$ 54,740,747	$ 61,634,852	$477,604,250	$261,010,746


KNIFE RIVER
SHOWING
PROPOSED IRRIGATION DEVELOPEMENT
AND
BRONCHO RESERVOIR
NORTH DAKOTA STATE WATER CONSERVATION COMMISSION
EXPLANATION
LAND FLOODED BY RESERVOIR
IRRIGABLE LAND
CANALS
GARRISON DAM
13 MILES
MISSOURI
RIVER
Stanton
Hazen
Beulah
Zap
Golden Valley
Dodge
MERCER COUNTY
OLIVER COUNTY
DUNN COUNTY
MORTON COUNTY
STARK COUNTY
DIVERSION DAM SITE
SIPHON UNDER RIVER
BRONCHO DAM SITE
RESERVOIR
Lateral 'D'
Lateral
Kinnaman
Brady
Otter
Creek
Brush
Elm
Little
Knife
Willow
Sheyenne
Coal
Antelope
Burke
Cedar
Canal
Bronchio
Great
Northern
Railway
Pacific

KNIFE RIVER FLOOD CONTROL—IRRIGATION—POWER

Appropriation was made by Congress for flood control works at or near Beulah, $87,000, and Hazen, $35,500, on the Knife river. It is planned to contract for this work in 1949. The Corps of Engineers will be in charge.

Congress also appropriated $102,700 for a sub-station at Beulah on the Fort Peck to Garrison dam transmission line.

Surveys are continuing on the Broncho dam and Knife river irrigation, and construction work is awaiting appropriations by Congress.

CANNONBALL RIVER DAM AND IRRIGATION

Surveys are completed by State Water Commission engineers for the construction of irrigation works on the two branches of the Cannonball river of 22,068 acres. Bureau of Reclamation engineers completed detailed plans for the Cannonball dam located about south of the town of Elgin. Congress made an appropriation of $400,000 and $580,000 for two years construction work and it is planned to contract for work to begin in the spring of 1949, to be completed in 1950.

Water for irrigation on the south branch, or Cedar river will come from a reservoir planned to be constructed north of Thunderhawk for which Congress has not as yet made appropriation.

MISSOURI RIVER PUMPING PROJECTS

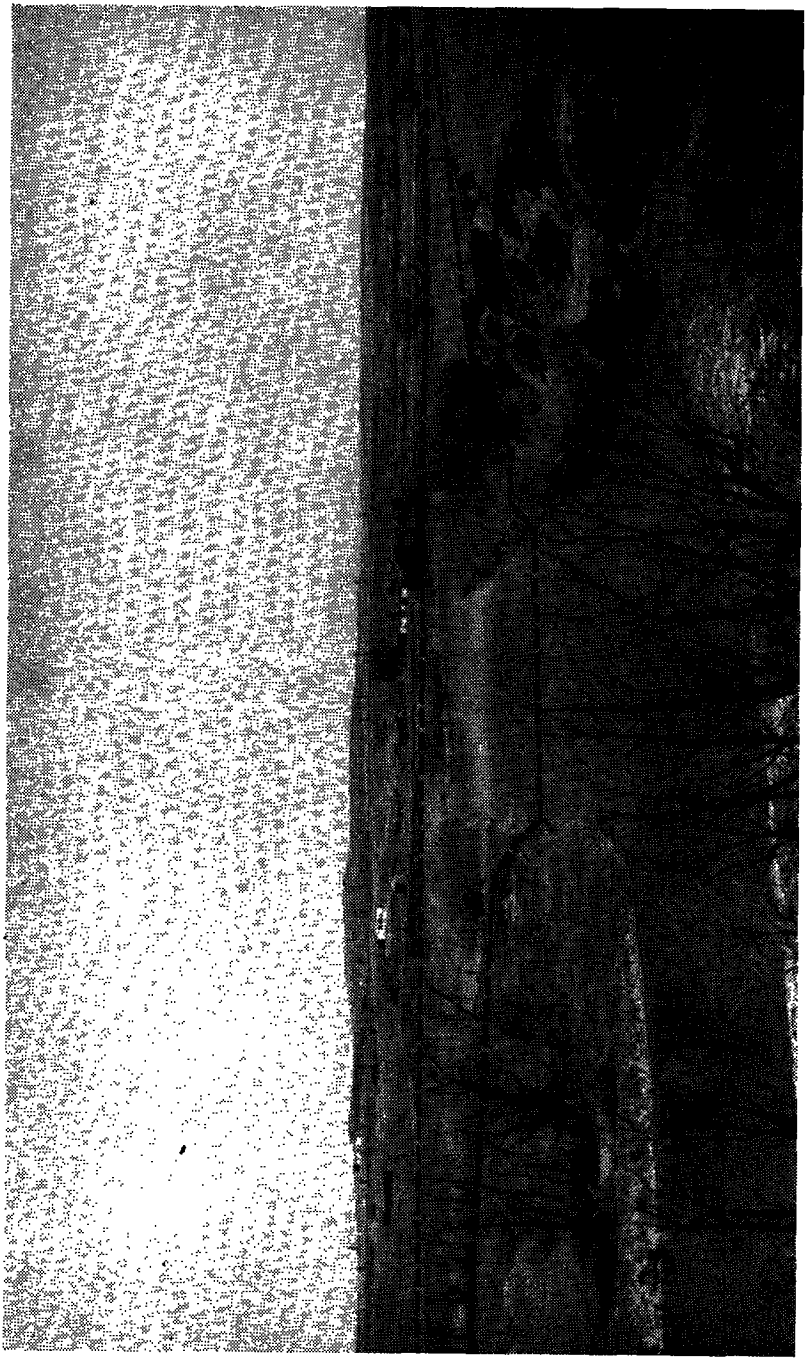
Surveys and specifications are being completed as rapidly as possible for irrigation by pumping from the Missouri river below the Garrison dam of areas found to be suitable for development.

The Fort Clark unit of 2,750 acres has been organized and construction is planned for 1949, which it is hoped to complete in one season. This will be the first demonstration in this area of the possibilities of irrigation by pumping.

It is planned to irrigate approximately 47,000 acres along the Missouri river by pumping. The projects include Hancock Flats, 5,030 acres; Fort Clark, 2,750 acres; Oliver-Sanger, 6,880 acres; Wogansport, 2,400 acres; Painted Woods, 2,300 acres; Square Butte, 2,750 acres; Burnt Creek, 1,940 acres; Bismarck, 9,000 or more acres; Little Heart, 2,930 acres; Horsehead Flats, 9,000 acres and Winona, 5,100 acres. These projects do not depend on the completion of the Garrison dam so construction can be pushed as rapidly as Congress provides funds,

THE BIG MISSOURI-SOURIS PROJECT

Construction work will actually begin in the spring of 1949 on the diversion dam from the Missouri river a few miles below Fort Peck dam, for which Congress appropriated $287,000. In addition $700,000



Site of the dam and reservoir on the Heart river near Dickinson, North Dakota

was appropriated for continuing surveys, plans and specifications and possibly starting construction on canals and pumping projects required to carry the water across northeastern Montana and northwestern North Dakota, on this million-acre irrigation project. Water from this immense project will fill up Devils Lake and surplus waters will help to fill the Bald Hill reservoir and reach Fargo and Grand Forks, more than six hundred miles away. The many details of surveys and planning for such an immense project take much longer to complete than originally estimated.

BOWMAN-HALEY FLOOD AND IRRIGATION PROJECT

The State Water Conservation Commission are investigating further the possibility of diverting water from the Little Missouri basin to augment natural flows for this project, if needed on a series of drought years. This project is for flood control as well as irrigation of about 5,000 acres in Bowman and Adams counties for feed for this great livestock area.

APPROPRIATIONS EXPLAINED

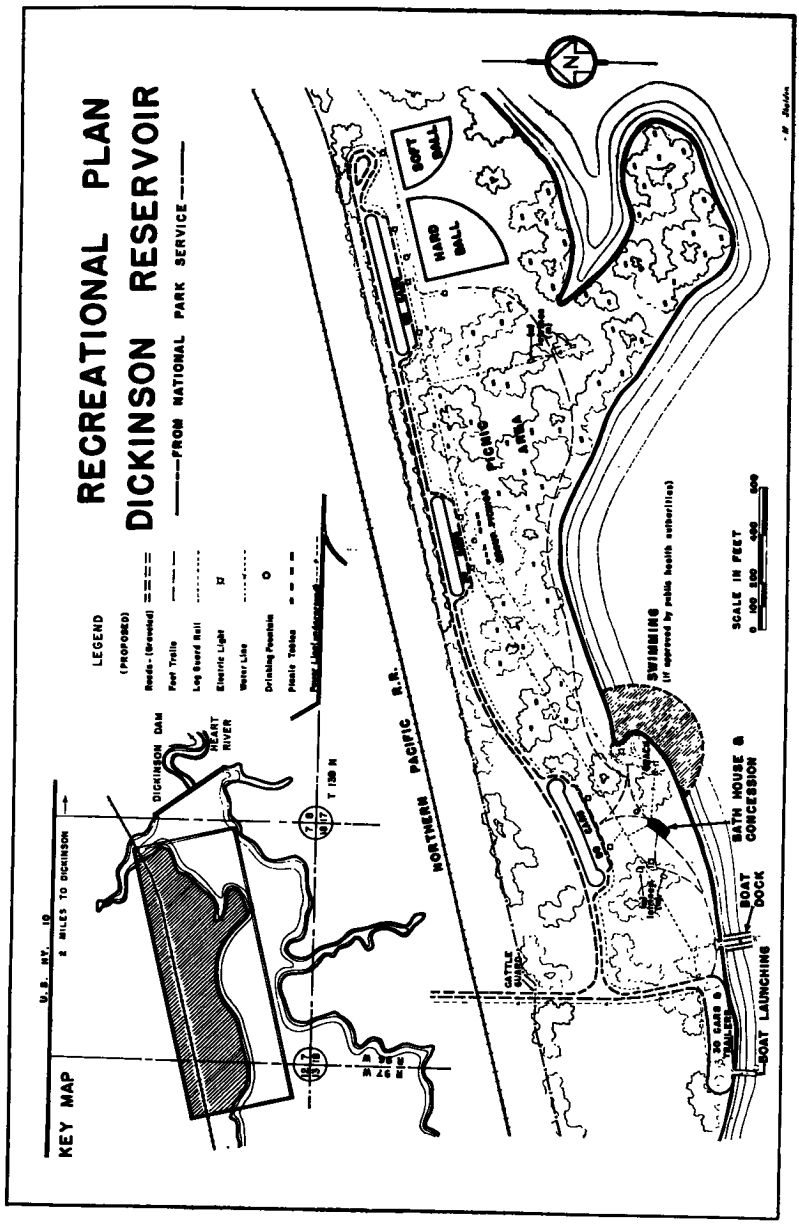
Readers of this report should keep in mind that it is contemplated to spend in North Dakota on water conservation and irrigation works approximately six hundred forty million dollars, largely from government appropriations within the next six, eight or ten years on projects which have already been approved by Congress as a part of the Missouri Basin six billion dollar "Pick-Sloan" plan. About thirty million dollars was appropriated for North Dakota projects by Congress for the fiscal year ending June 30, 1948, and about thirty-five million dollars for the year ending June 30, 1949. Each year the tempo of construction is to be stepped up to make it average almost seventy-five million dollars, on the greatest water development program in the history of the world. The work of the State Water Conservation Commission has been a big factor in securing the cooperation of governmental agencies in enlarging and extending the program. Appropriations listed reflect some of its activities:

Commissioner Per Diem and Expenses

This is for compensation and expenses of the members for actual days of service at the rate of $7 per day and actual travel expenses. This is less than the actual earning of any member of the Commission, and in many instances members are compelled to pay part of their expenses from their own pockets because of limitations of the state law. This indicates a spirit of public service for the future welfare of the state.

Administration

This is a continuing appropriation to cover the part of the expenses of the office which the word implies and which are not covered by other specific appropriations. It covers largely the clerical work and super-


RECREATIONAL PLAN
DICKINSON RESERVOIR
FROM NATIONAL PARK SERVICE
LEGEND
(PROPOSED)
Roads - (Gravelled)
Foot Trails
Log Guard Rail
Electric Light
Water Lines
Drinking Fountain
Picnic Tables
KEY MAP
U.S. HY. 10
2 MILES TO DICKINSON
DICKINSON DAM
HEART RIVER
T 139 N
NORTHERN PACIFIC R.R.
SOFT BALL
HARD BALL
PICNIC AREA
SWIMMING
(If approved by public health authorities)
BATH HOUSE & CONCESSION
BOAT DOCK
BOAT LAUNCHING
CATTLE GUARD
SCALE IN FEET
0 100 200 400 600
N

vision, with necessary stationery, postage, supplies, etc., required in the conduct of the office and state-wide supervision of the progress of the different activities. Amounts collected on refunds and collections help to serve as a revolving fund and are deposited with the State Treasurer.

Maintenance of Existing Dams

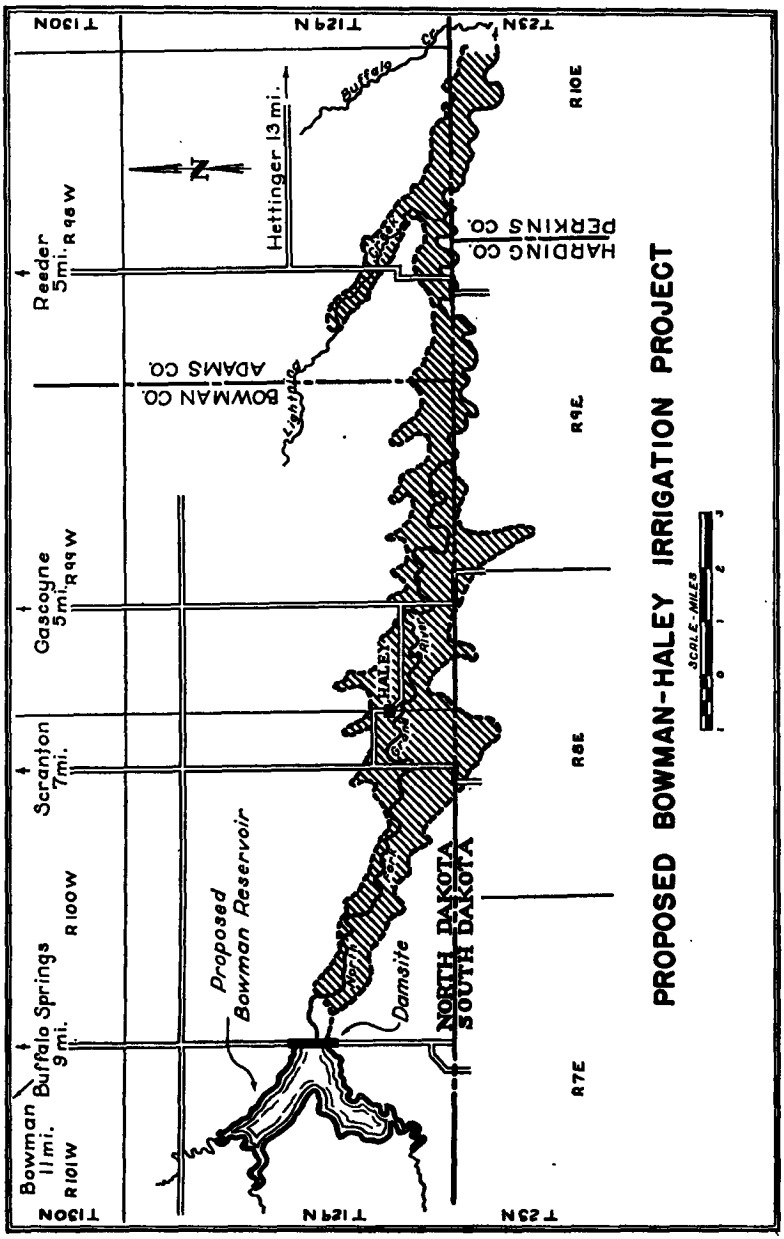
Different Federal agencies built numerous dams during the drought years of the thirties to conserve water for farmers, stockmen, municipal use, and to provide places for recreation and conservation of wild life. Maintaining these dams has been a cooperative project of the nearby municipalities, the counties and the State Water Conservation Commission. Spillways were not constructed strong enough to withstand continuous undermining of the waters, hence rebuilding and strengthening are commonly necessary to save these valuable water-saving structures. The engineers of the Water Commission inspect, design and supervise repairs needed. The State Game and Fish Dept. has cooperated on the cost of repairs of those dams on which the depth of the water permits the propagation of fish and wild life.

International and Interstate Commissioner and Conference Expense

Preliminary conferences on the immense Missouri river basin flood control, irrigation, navigation and electric generating plan has required many conferences with border states, basin states and national agencies. This entails a considerable expense for transportation and living of members of the Water Commission and representatives of the state. It included appearances before Congressional committees when considering appropriations for North Dakota construction work. It is necessary in order to protect the interests of the state as between states and secure returns which are many times larger than the expense incurred and will mean much to the future stability of agriculture and stockraising, hydroelectric power, municipal water supplies, flood control, recreational centers, etc.

Topographic and Conservation Branches in Cooperation with U. S. on 50-50 Basis

The surveying and preparation of topographic maps has been completed over a large portion of the U. S. by the Geological Survey engineers. The State Water Conservation Commission enters into agreements with this U. S. department from year to year to continue topographic mapping in the areas where irrigation works are planned. This has been along the Sheyenne and James rivers, in the areas where irrigation is planned around and easterly from the Garrison dam, and down the two sides of the Missouri river, as well as on the tributaries west of the Missouri river. The areas of the million-acre Missouri Souris irrigation project are being covered in cooperation with the Bureau of Reclamation. The work is done by a fifty-fifty arrangement by state and


PROPOSED BOWMAN-HALEY IRRIGATION PROJECT
SCALE-MILES
Bowman 11 mi.
Buffalo Springs 9 mi.
Scranton 7 mi.
Gascoyne 5 mi.
Reeder 5 mi.
R 101 W
R 100 W
R 99 W
R 98 W
T 130 N
T 129 N
T 23 N
R 7 E
R 8 E
R 9 E
R 10 E
Proposed Bowman Reservoir
Damsite
NORTH DAKOTA
SOUTH DAKOTA
BOWMAN CO.
ADAMS CO.
HARDING CO.
PERKINS CO.
Hettinger 13 mi.
Buffalo
Cedar Creek
Cabin Creek
HALEY
Grand River
N

government funds. The importance of having these surveys completed before irrigation construction planning is started cannot be overemphasized, because of the saving of expense on planning and the increased speed of construction which results.

Hydrographic Surveys, Cooperation with U. S. Geological Survey

Reliable information giving stream flow measurements is absolutely essential before the engineer can make dependable plans and specifications for dams, reservoirs, water power, irrigation and flood control, and the longer period covered by this data the more dependable it will be as to what has happened in past years and is likely to happen in coming seasons.

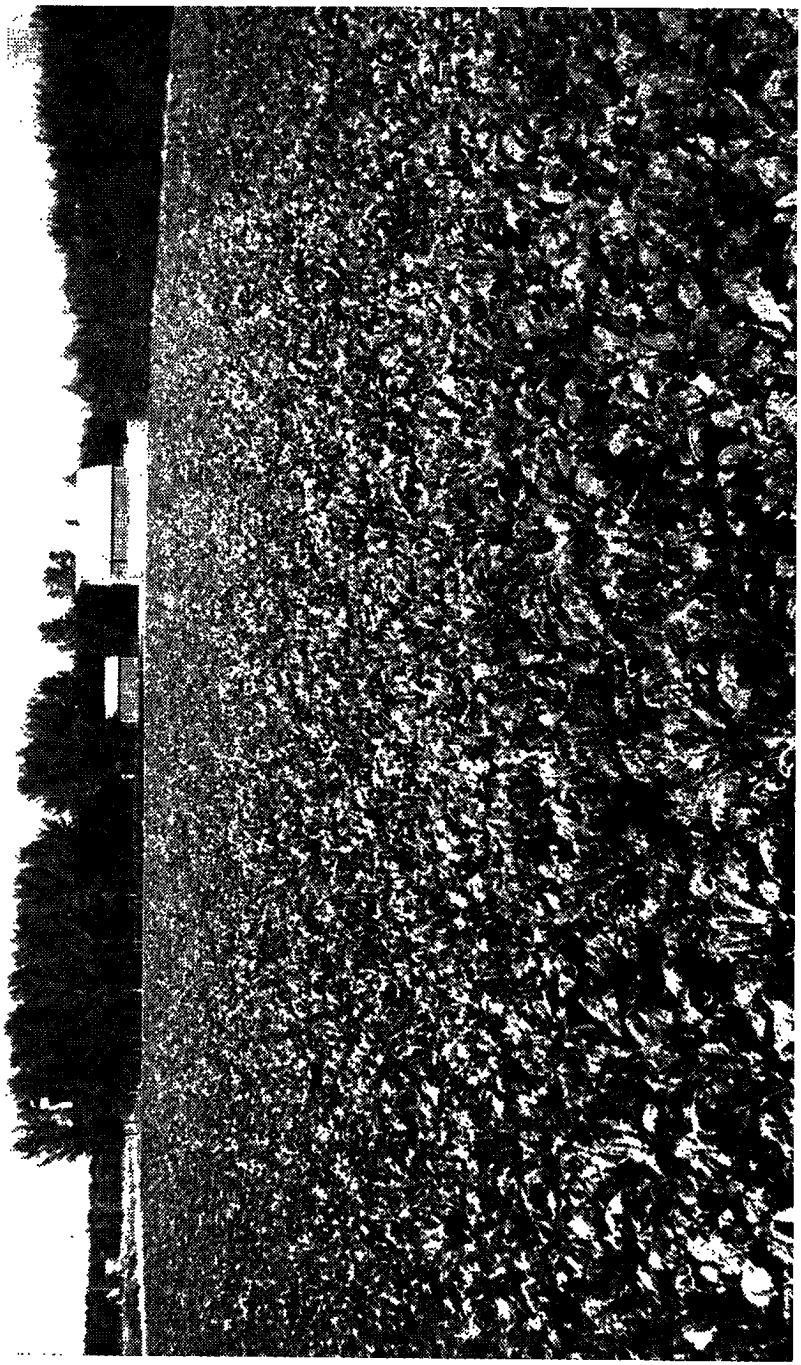
These records of minimum and maximum flow of streams indicate to the engineer the size needed on proposed reservoirs to hold back flood waters and what acreage can be irrigated over drought seasons from the impounded water. Half the cost is paid from government funds.

Salary, State Engineer

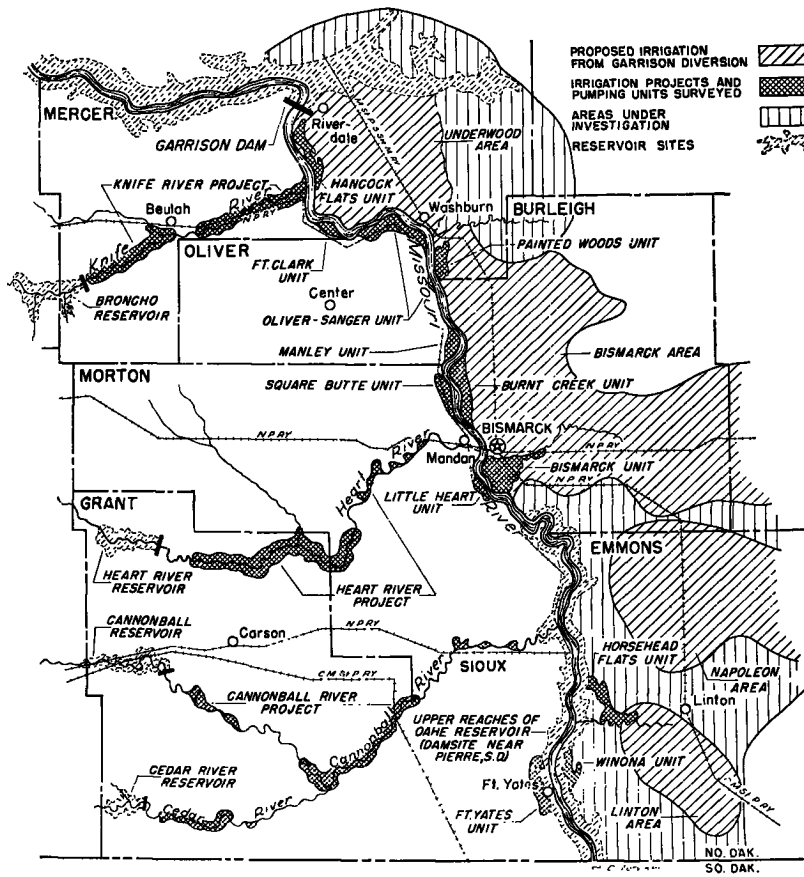
The Executive Secretary and Chief Engineer of the State Water Conservation Commission is also designated by law as the State Engineer, the supervisor of the use of all of the waters of the state, and with many other duties prescribed by law. He arranges contracts for topographic and hydrographic surveys in the state with the government agencies, with half the cost paid from government funds; for cooperative plans and surveys by the Bureau of Reclamation and the Corps of Engineers, approves designs, plans and specifications for the construction of dams and irrigation works; and is a member of the Mouse (Souris) River Commission which controls and regulates the distribution of Mouse river waters within the state.

Reconstruction Drains or Irrigation

A government statistician's survey estimated that the loss from the flooding of crop lands in the Red River valley in 1943 and 1944 was more than twenty-four million dollars, and emphasized the need of repair and cleanout of existing drainage channels and the construction of additional drainage ditches. The 1943 state legislature appropriated $50,000, the 1945 session $240,000 and the 1947 session $200,000 for this purpose. This money was allocated by the State Water Conservation Commission to the different Red River valley counties in proportion to the percentage of flood damage on the basis of 40% of the construction cost paid from state funds, with 60% paid by counties or drainage districts. Arrangements were made with the Soil Conservation Service to use their big machinery on work supervised by their engineers using government funds, which has aided much in improving drainage of crop lands. Delays have been encountered so there is a lot of work to be done to complete the program which will pay for itself manifold in the years to come in added crop returns.



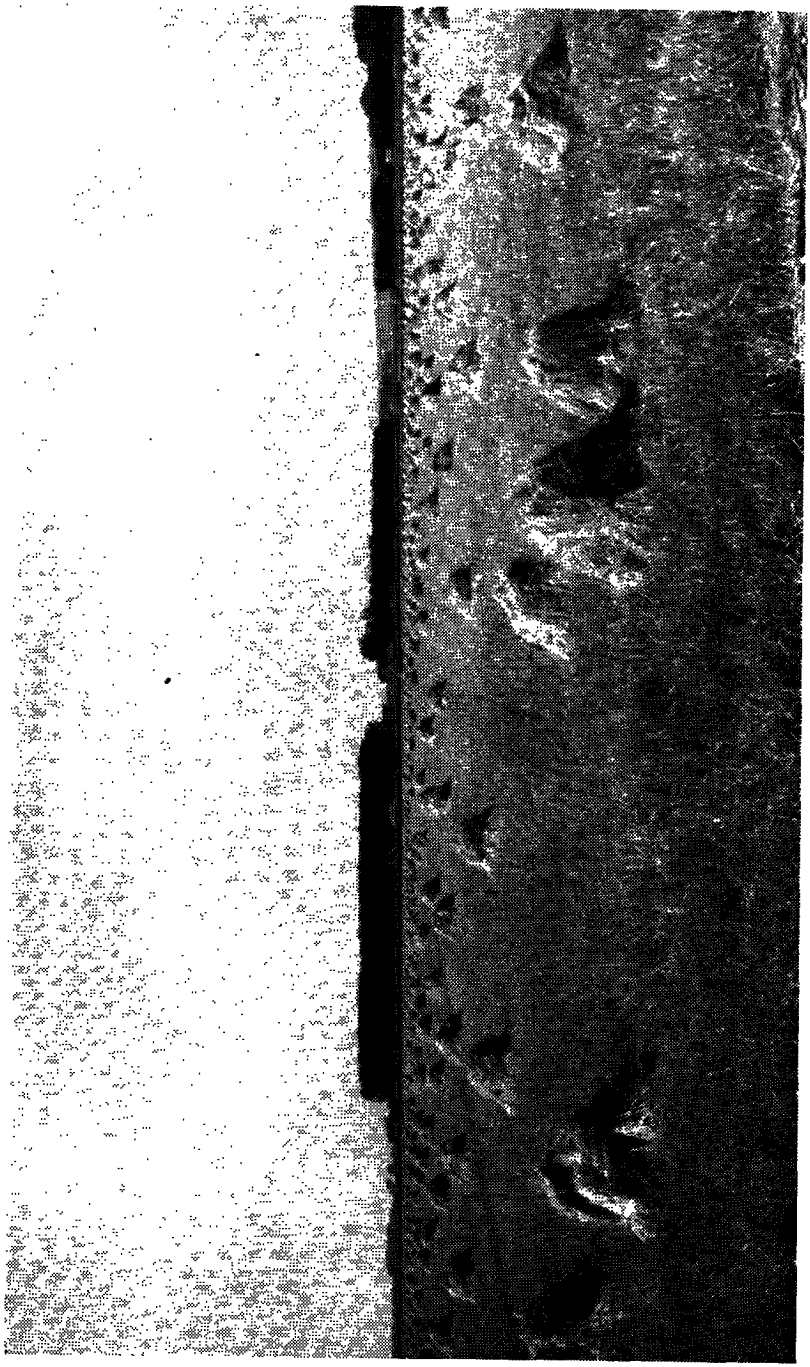
Sugar beets under irrigation are yielding from $75 to $150 gross per acre in western North Dakota



Central North Dakota Proposed Irrigation

Engineering and Geological Surveys and Demonstrations

More than seventy communities in North Dakota have requested assistance from the State Water Conservation Commission to find suitable potable water for their needs. This appropriation is used mostly in that work, under the supervision of the State Geologist, representing the Water Commission. All state funds are being matched by agreement by the U. S. Geological Survey under an agreement with this Commission to carry on this investigational work. The different municipalities requesting aid are also required to pay a proportionate share of the cost of the investigation. A portable rotary drill and truck with tank were purchased by the Water Commission for this work. About one-third of the communities making requests for help have been surveyed with remarkable success in finding needed water. It appears that this work



Irrigated oats and barley, John Hardy farm on Lower Yellowstone Irrigation District.

should be continued indefinitely because of the increasing number of communities which must have potable water and find that the former used shallow well supply is insufficient for their needs.

Postwar Projects in Cooperation with U. S. Departments and for Organizing Conservation and Irrigation Districts

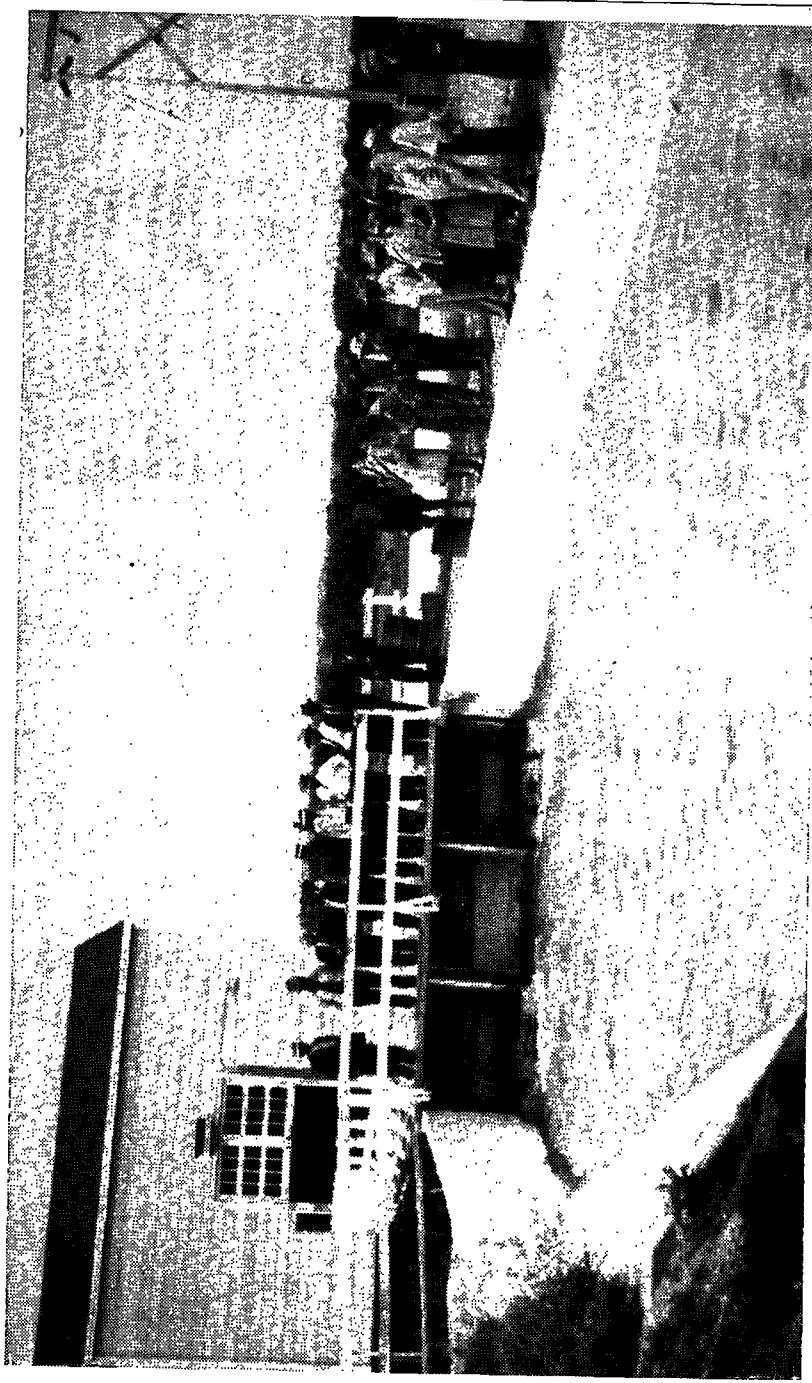
This has been used on a fifty-fifty basis with government funds in cooperation with the Bureau of Reclamation engineers on studies, investigation and preliminary surveys where there is a prospect of developing additional acreages under irrigation to be added to the government development, and for the organization of conservation and irrigation districts. This type of work will increase as the immense proposed irrigated areas in the state are developed under the Missouri basin development "Pick-Sloan" plan, possibly finally including one and a half to two million acres in North Dakota.

Other Investigations, Surveys, Etc.

These funds enable the Water Commission to have its engineers make surveys, investigations and plans for prospective irrigation of areas not included in the original plan of the Bureau of Reclamation. This information if it appears from the surveys as feasable is presented to the Bureau of Reclamation engineers with request that the additional acreage be added if possible to the irrigation development. And, in the case of the Heart and Cannonball river areas, by having engineers of the Water Commission make the topographic surveys, the work of construction has been speeded up at least two to three years and construction actually begun. This summer, topographic surveys of the Underwood area are being made by Water Commission engineers under the direction of the Bureau of Reclamation with the hope that irrigation construction work may be completed and ready to use Garrison reservoir waters when available.

Construction Bond Guaranty Fund

This is a revolving fund provided by the legislature to enable the State Water Conservation Commission to give additional security to its bond issues to raise funds for irrigation construction when needed, thus making the bonds more marketable at a lower rate of interest because of the added security. No losses have been incurred and it is expected that the full amount now on deposit with the Bank of North Dakota with bonds outstanding will be returned to the fund. It is expected that there will be many small irrigation projects scattered over the state to be financed through the Water Commission in coming years.



Pumping Station on Buford-Trenton Irrigation District, west of Williston, N. D.

MAINTENANCE OF EXISTING DAMS

During the drought years some 1,200 dams were built in North Dakota by Federal Agencies. The reservoirs of these dams served a number of conservation needs. They provided water for small irrigation projects; water for stock; source of water for municipal supplies; created community recreation areas where picnicking, swimming, boating, and fishing were available, and provided areas beneficial to wildlife.

When the Federal Works terminated this program no organized maintenance and repair program was advanced, and the counties were charged with the responsibility of maintenance. The work could be financed by county general funds, but no special levies could be made for the purpose. The difficulty of financing made the dam maintenance task a job too extensive for the counties to handle. In order to meet this conservation need, the state legislature appropriated limited funds to the State Water Commission to assist in carrying out a program for repair and maintenance of existing dams.

This program provides for the repair and reconstruction by the Water Commission. These projects are financed on a cooperative basis with local agencies, the State Game and Fish Department, the State Water Conservation Commission and counties participating in the cost. The Game and Fish Department is restricted to sharing in cost of projects which have value to wildlife. In order to insure statewide benefit, the Water Commission is limited in its expenditure to $500 on any project. In cases where the cooperative share exceeds this amount, the commission by special resolution may allocate additional funds. The majority of the projects repaired by the commission have been small maintenance jobs.

Watford City, N. D. Reservoir Spillway Repaired

STATE WATER CONSERVATION COMMISSION
Investigations, Surveys, Plans, Estimates, Construction Completed
"Maintenance of Existing Dams," 1947-49 (Oct. 1, 1946 - Nov. 30, 1948)

Name	Project No.	County	Water Commission	Game & Fish	Local	Total Cost
Antelope Creek	246	Oliver	$ 73.86	$	$ 49.37	$ 123.23
Apple Creek	412	Burleigh	995.40	3,983.71	1,930.77	6,909.88
Epping	346	Williams	142.00	142.00	142.00	426.00
Kathryn	399	Barnes	617.65	500.00	500.00	1,617.65
Lisbon	316	Ransom	236.88	170.68	170.68	578.24
Odland	394	Golden Valley	170.13	.....	.....	170.13
Pembina	299	Pembina	788.36	.....	1,914.78	2,703.14
Raub	407	Williams	332.34	332.33	332.33	997.00
Regent	350	Hettinger	550.27	550.27	550.26	1,650.80
Silver Lake	391	Sargent	768.58	500.00	594.00	1,862.58
Squaw Creek	417	Hettinger	413.45	.....	413.44	826.89
Strawberry Lake	431	McLean	427.07	300.32	.....	727.39
Tolna No. 1	266	Nelson	342.99	250.00	140.92	733.91
Tolna No. 2 (Snortland)	404	Nelson	1,209.04	1,404.95	2,809.92	5,423.91
Braddock	264	Emmons	137.22	137.22	137.21	411.65
Cedar	353	Slope	224.74	224.73	224.73	674.20
Coyote Creek	388	Bowman	134.08	134.08	134.07	402.23
Danielson	402	Morton	333.83	333.83	333.82	1,001.48
Hanson	462	Barnes	515.13	515.12	515.12	1,545.37
Hebron	317	Morton	94.22	94.22	94.22	282.66
Lidstrom	427	Morton	69.39	69.38	69.38	208.15
Neche	274	Pembina	173.75	173.75	173.75	521.25
Regent	350	Hettinger	6,013.54	6,013.54	3,754.74	15,781.82
Ueland	460	Griggs	199.24	199.23	199.23	597.70
Watford City	440	McKenzie	5,485.37	5,485.37	1,800.00	12,770.74
			$20,448.53	$21,514.73	$16,984.74	$58,948.00

MAINTENANCE OF DAMS, CONTINUED

Following is a list of the projects in which the State Water Commission cooperated during the biennium, on investigations, surveys, plans or estimates for proposed future work:

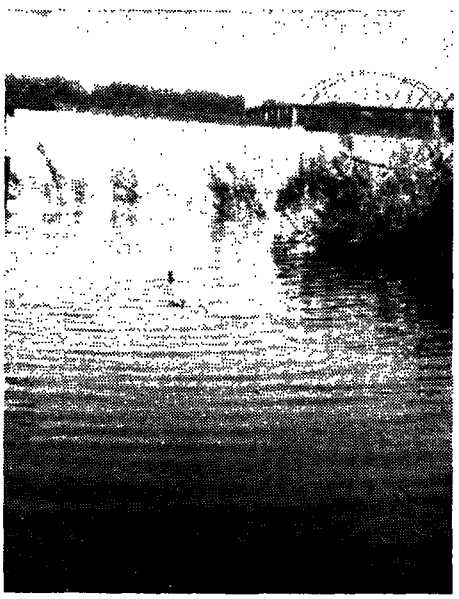
Oct. 1, 1946 to Nov. 30, 1948

Project No.	Dam	County	Amount Expended
418	Amenia	Cass	$ 49.05
433	Assumption Abbey	Stark	152.40
300	Baldhill Reservoir	Barnes	72.31
362	Balta	Pierce	10.68
215	Bismarck Irrigation	Burleigh	66.21
454	Boyd	McHenry	14.13
216	Bowman-Haley	Bowman	103.29
221	Burlington Resettlement	Ward	168.22
446	Crawford	Slope	13.54
263	Dickinson	Stark	17.29
445	Fischer Lake	Stutsman	152.37
287	Fort Clark	Oliver	141.50
456	Frojen	Dickey	42.09
261	Heart Butte Dam	Morton-Grant	81.08
416	Lake Irvine	Ramsey	33.37
443	Jaunita Lake	Foster	546.96
354	Jamestown	Stutsman	15.18
242	Jund	McIntosh	21.19
430	Klandl	McKenzie	165.92
410	Kottsick	Morton	20.38
408	Lake Tewaken	Sargent	15.85
426	Leland Irrigation	McKenzie	223.12
432	Magill	LaMoure	4.70
422	Manny	Oliver	13.88
448	Minto Drainage	Walsh	27.08
451	Myrnak	Bowman	27.96
260	Olson	Burleigh	$ 77.24
250	Paulson	Mountrail	50.77
336	Powers Lake	Burke-Mountrail	349.38
419	Quam	Nelson	16.65
428	Rausher	Grant	35.86
452	Schaffer	Ward	7.07
455	Schultz	McHenry	27.93
245	Soland Dam	Mercer	13.00
344	State Line	Dickey	21.19
450	Sykeston	Wells	67.81
414	Tatley	Burleigh	13.00
319	Wakopa	Rolette	346.18

Project No.	Dam	County	Amount Expended
380	Williams Creek	Golden Valley	28.88
360	Willow Lake	Rolette	10.68
413	Willson Creek	Bottineau	20.08
359	Wolf Butte	Adams	117.71
364	Yanktony	McLean	236.60

WATER RIGHT APPLICATIONS

Section 61-0402 of the North Dakota code reads, "Application for Beneficial Use of Water Required. Any person, association, or corporation intending to acquire the right to the beneficial use of any waters, before commencing any construction for such purpose, or before taking the same from any constructed works, shall make an application to the State Engineer for a permit to appropriate."



Missouri river at Bismarck, highway bridge in background.

WATER RIGHT FILINGS

Applied for since October 1, 1946
(Addition to list compiled on that date)

No.	Name of Applicant	Source of Supply	Tributary to	Amount of Water Claimed Gals. per day	Date of Claim
	GREAT NORTHERN RAILWAY CO. (Water Stations) (Location by Towns)				
258	Casselton	Swan Creek	Maple River	75,000	Jan. 15, 1947
259	Des Lacs	Big Mary's Coulee	Mouse River	20,000	Jan. 15, 1947
260	Hannaford	Bald Hill Creek	Sheyenne River	75,000	Jan. 15, 1947
261	Kindred	Sheyenne River	Red River	50,000	Jan. 15, 1947
262	Mason	Rush River	Sheyenne River	10,000	Jan. 15, 1947
263	Minot	Mouse River	Assiniboine River	500,000	Jan. 15, 1947
264	New Rockford	James River	Missouri River	100,000	Jan. 15, 1947
265	Ray	Beaver Creek Coulee	Missouri River	50,000	Jan. 15, 1947
266	Spring Brook	Stony Creek	Missouri River	10,000	Jan. 15, 1947
267	Stanley	Unnamed Coulee	Little Knife River	*	Jan. 15, 1947
268	Stanley	Little Knife River	Missouri River	100,000	Jan. 15, 1947
269	Stanley	Unnamed Coulee	Little Knife River	*	Jan. 15, 1947
270	Verendrye	Mouse River	Assiniboine River	50,000	Jan. 15, 1947
272	Cavalier	Tongue River	Pembina River	15,000	Feb. 10, 1947
273	Churchs Ferry	Mouvaise Coulee	Devils Lake	25,000	Feb. 10, 1947
274	Deep	Deep River	Mouse River	5,000	Feb. 10, 1947
275	Devils Lake	Sweetwater Lake	.....	190,000	Feb. 10, 1947
276	Edmore	Unnamed Coulee	Sweetwater Lake	12,000	Feb. 10, 1947
277	Finley	Goose River	Red River	10,000	Feb. 10, 1947
278	Grafton	Park River	Red River	15,000	Feb. 10, 1947
279	Granville	Unnamed Coulee	Mouse River	30,000	Feb. 10, 1947
280	Hillsboro	Goose River	Red River	30,000	Feb. 10, 1947
281	Landa	Mouse River	Assiniboine River	10,000	Feb. 10, 1947
282	Langdon	Mulberry Creek	Pembina River	14,500	Feb. 10, 1947
283	Larimore	Turtle River	Red River	75,000	Feb. 10, 1947
284	Leeds	Unnamed Creek	Devils Lake	75,000	Feb. 10, 1947
285	Mayville	Goose River	Red River	10,000	Feb. 10, 1947
286	Michigan	Unnamed Coulee	Turtle River	15,000	Feb. 10, 1947
287	Neche	Pembina River	Red River	6,000	Feb. 10, 1947
288	Niagara	Unnamed Coulee	Turtle River	30,000	Feb. 10, 1947
289	Park River	Park River	Red River	5,000	Feb. 10, 1947
290	Towner	Mouse River	Assiniboine River	20,000	Feb. 10, 1947

*Water to be diverted included in #268.

WATER RIGHT FILINGS

Applied for since October 1, 1946
(Addition to list compiled on that date)

No.	Name of Applicant	Lands to be Irrigated	Source of Supply	Amount of Water Claimed in Second Feet	No. of Acres	Date of Claim
291	Ernest L. Leland	NW¼SW¼, S½SW¼, S½SE¼, Sec. 15-147-103; SE¼NE¼, NE¼SE¼, SE¼SE¼, Sec. 17-147-103; NE¼NW¼, N½NE¼, Sec. 21-147-103; S½NW¼, SW¼NE¼, SW¼, SE¼, Sec. 16-147-103.	Hay Draw, Sheep Creek & Bennie Pierre, tributary to Yellowstone River	5.6	446	Jan. 22, 1947
271	Alois Klandl	NE¼NE¼, Sec. 26-148N.-105W.; N½NW¼, SW¼NW¼, Sec. 25-148N.-105W.	Branch of Bennie Pierre Creek, tributary to Yellowstone River	.97	77.4	Jan. 25, 1947
292	Grafton, City of	Municipal water supply.	Park River, tributary to Red River	300,000,000 gal. per annum		Feb. 26, 1947
293**	U. S. Dept. of Agriculture	NW¼SE¼, SW¼SE¼, Sec. 33-139-81.	Heart River, tributary to Missouri River	.5	12	Mar. 3, 1947
294	Ronald E. Stuart	SE¼NW¼, SW¼NE¼, NW¼-SW¼, Sec. 10-132-106.	Little Missouri River, tributary to Missouri River	.67	26.6	Mar. 25, 1947
295	Lawrence Fradet	SE¼SW¼, SW¼SE¼, Sec. 18-138-49.	Sheyenne River, tributary to Red River	1.9	65	Mar. 27, 1947
296	Wendel Sand	SE¼SW¼, SW¼SE¼, Sec. 26-142-94.	Deep Creek, tributary to Knife River	.75	60	May 8, 1947
297	W. T. Krebsbach	NW¼SW¼, Sec. 34-133-98.	Cedar Creek Reservoir, tributary to Cannon Ball River	.5	40	May 26, 1947
298	Edward Hammer	NW¼SE¼, SW¼SE¼, Sec. 7-153-79.	Souris River	.5	24.3	Aug. 13, 1947

**This application submitted to replace the original application filed in 1920.

WATER RIGHT FILINGS

Applied for since October 1, 1946
(Addition to list compiled on that date)

No.	Name of Applicant	Lands to be Irrigated	Source of Supply	Amount of Water Claimed in Second Feet	No. of Acres	Date of Claim
299	Coca Cola Bottling Company, Devils Lake	Ramsey County, N. D.	Sweetwater Lake	5,000 gallons per day		Sept. 30, 1947
300	Gene F. Pelton	NW¼SW¼, SW¼SW¼, Sec. 23, Twp. 140, Rge. 95. SE¼SE¼, Sec. 22, Twp. 140, Rge. 95.	Green River, tributary of Heart River	0.5	25	Jan. 15, 1948
301	Anton J. Fisher	NW¼SW¼, Sec. 22-140N-95W, Stark County.	Green River, tributary of Heart River	0.75	....	Feb. 11, 1948
302	Minnkota Power Cooperative, Inc. Grand Forks	SW¼NW¼, Sec. 34-152-50.	Red River of the North	10 ac. ft. annual use	....	May 20, 1948
303	Northern States Power Company, Minneapolis	NE¼SW¼, Sec. 3-154-82, Ward County.	Souris River	2.0	....	May 27, 1948
304	Lavoy & Scheffler	SW¼NW¼, Sec. 5-150-66	Sheyenne River	1½	....	June 30, 1948
305	C. H. Kempton	SE¼SE¼, Sec. 31, Twp. 135, Rge. 95.	Cannonball River	3/80	3	July 26, 1948
306	Earl C. Rundle	SE¼NE¼, NE¼SE¼, Sec. 32, Twp. 136, Rge. 99.	Cannonball River	1	29.8	July 27, 1948

WATER RIGHT FILINGS
APPLICATIONS PENDING

No.	Name of Applicant	Municipal Water Supply	Source of Supply Baldhill Reservoir	Amount of Water Claimed in Sec. Feet	Date of Claim
	American Crystal Sugar Co.	NE¼NW¼ 5-139-48	Sheyenne River	7.75 c.f.s.	June 4, 1948
	City of Fargo	NW¼NW¼ 5-138-49.	Sheyenne River	0 to 25	June 5, 1948
	Grand Forks	NE¼SE¼ 10-151-50.	Sheyenne River	0 to 10	June 8, 1948
	Great Northern Railway	NE¼NW¼ 5-136-50.	Sheyenne River	g.p.d. 50,000	June 9, 1948
	Northern Pacific Railway		Sheyenne River		
	Soo Line Railway	SW¼NE¼ 16-140-58.	Sheyenne River	0.0297	June 14, 1948
	Northern States Power Co., Fargo, N. Dak.	In City of Fargo 4th St. S. and 4th Ave. S. Projected to Red R.	Sheyenne River	1.33	June 14, 1948
	Union Stock Yards, West Fargo, N. D.	NE¼ 6-139-49	Sheyenne River	g.p.d. 1,500,000	June 28, 1948
	Valley City		Sheyenne River	0 to 2	Pending
	Lisbon		Sheyenne River	0 to 1	Pending
	West Fargo		Sheyenne River	0 to 5	Pending
	Moorhead		Sheyenne River	0 to 4	Pending

FINANCIAL STATEMENT

As of October 31, 1948
1947-1949 Appropriations

Appropriation for	July 1947	Expended	Balance
Commissioner's Per Diem and Expenses	$ 4,000.00	$ 1,936.88	$ 2,063.12
Administration	30,000.00		
Plus Refunds and Collections	5,081.62	15,495.35	*19,596.27
Maintenance of Existing Dams	45,000.00		
Plus Refunds and Donations for Dam Repairs	5,883.17	41,615.06	9,268.11
Tri-State Waters and Portion of Administration and Conference Expenses	1,000.00	112.79	887.21
International and Interstate Compacts	10,000.00	4,782.23	5,217.77
Topographic and Conservation Branches, Cooperation with U. S. Geological Survey	30,000.00	13,649.20	*16,350.80
Hydrographic Surveys, Cooperation with U. S. Geological Survey	20,000.00	12,526.45	7,473.55
State Engineer's Salary	5,400.00	3,600.00	1,800.00
Reconstruction of Drains or Irrigation	200,000.00	9,248.33	*190,751.67
Engineering and Geological Surveys and Demonstrations	30,000.00	14,527.49	* 15,472.51
Postwar Projects, Cooperation with U. S. Departments	135,000.00	90,013.30	* 44,986.70
Other Investigations, Surveys, Etc.	90,000.00	46,981.08	* 43,018.92
Construction Bond Guaranty Fund	70,541.00	Nil	70,541.00
	$681,905.79	$244,219.47	$427,417.63

* Current bills pending and balances mostly pledged.

BONDS OUTSTANDING

As of October 30, 1948

Refunding bonds, Series J, were issued in 1944 and mature serially on or before Dec. 10, 1955.

$63,000. Interest rate, 2%. Sold to the Bank of North Dakota. This money was borrowed to finance irrigation construction, for which the irrigation districts gave bonds to the Water Commission. $47,078.26 has been collected and deposited in the sinking fund with the Bank of North Dakota. $25,000 bonds of the Sioux Irrigation District in McKenzie County are held as collateral. In addition $19,459 from the Bond Guaranty Fund has been deposited as collateral as additional guarantee for these bonds and to be used only in case of default of interest or principal payments. $65,000 from the sinking fund and guarantee fund has been invested in government bonds drawing 2½% interest, thus making ½% margin over the 2% interest on the bonds. Judge A. M. Christianson is entitled to credit for negotiating the sale of these bonds on an unusually favorable basis for the state and the irrigation districts.

DEHYDRATING ALFALFA

One of the most profitable and fool-proof crops under irrigation is alfalfa. It is commonly planted in a three, four or five-year rotation with other crops, because of its soil fertility building qualities. Some gross yields per acre have equalled other high-paying crop returns, such as sugar beets.

Many dehydrating plants are being installed in irrigated areas which remove from 90 to 93 per cent of the weight in moisture before running the alfalfa through a mill which produces alfalfa meal. Taking out 90 per cent of the weight reduces the freight and extends the radius of the market. The alfalfa meal is sold largely to stock food manufacturers as a base for stock foods, and sixty per cent is said to go into poultry foods.

Dehydrating plants are one type of industry which spring up in irrigated areas, and no doubt this will be true in North Dakota. Some of these plants cost as much as $60,000 and are equipped with power mowing machines, choppers, blowers, covered racks, so that all the work is done by power and none by hand. The alfalfa is bought standing and the farmer has no harvesting problems, nor curing of the feed before storing. There is also on the market a portable dehydrating machine which can be hauled by a tractor to the field being cut. Crude oil is the fuel commonly used.

BOOKLET FOR SCHOOL USE

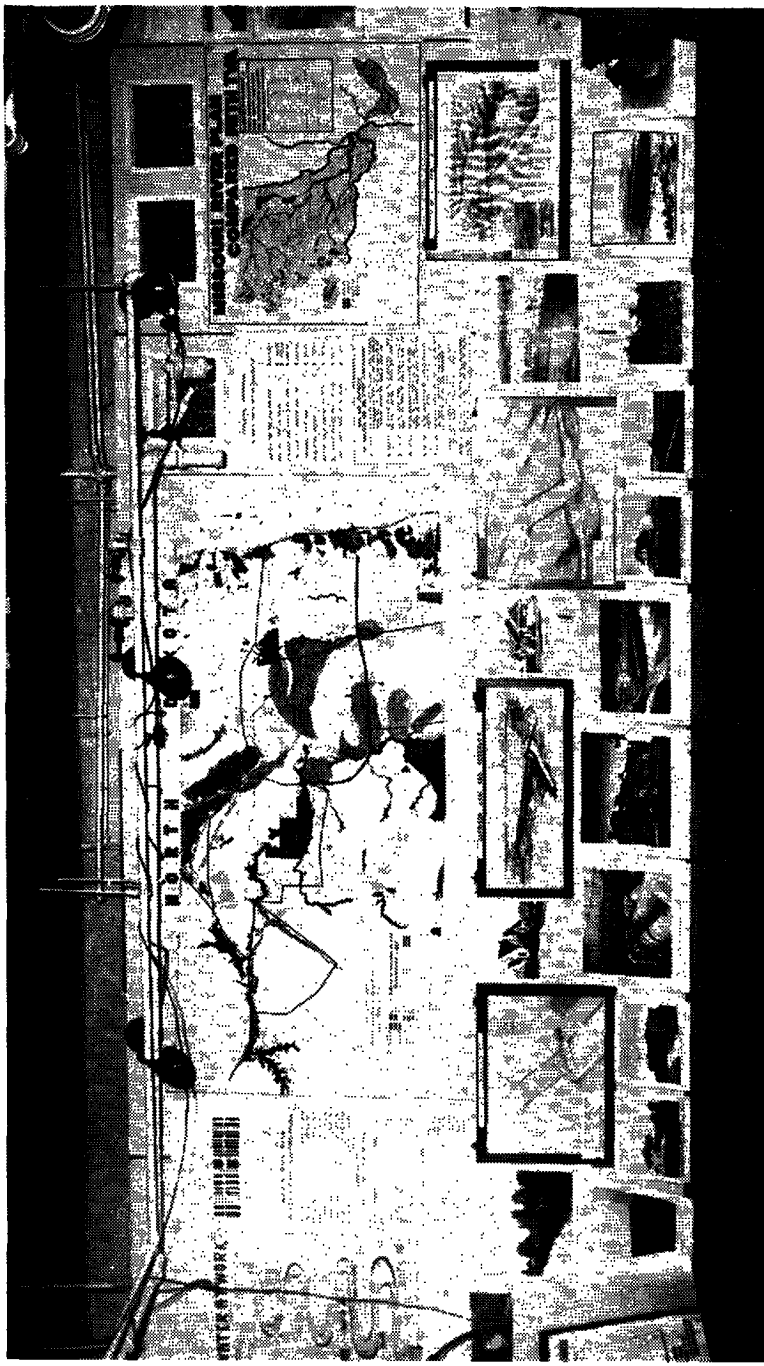
A text book telling of the Missouri river Pick-Sloan development plan has been published by the State Water Conservation Commission

at the suggestion of State Superintendent G. B. Nordrum, for use in the seventh and eighth grades, but also as supplemental reading in the high schools. The thought behind it is that the young people of the state will live to see the water development in operation and should know in advance of the changes which will result and the opportunities it will give for a more prosperous and stabilized agriculture and stockraising, as well as in all lines of business to service the needs of farmers. County Superintendents are distributing the booklets.

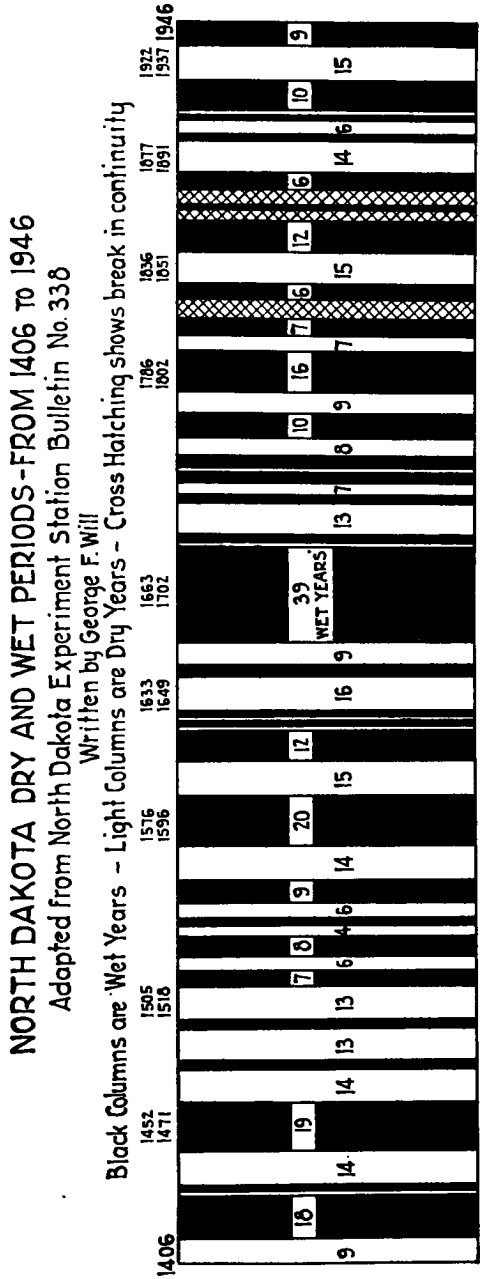
EDUCATIONAL EXHIBITS

There has developed since actual construction began on the Missouri river water development plan, an increasing demand for information regarding the program and how it will affect the different localities. Informational maps and circulars and copies of addresses and radio talks by officials of the Corps of Engineers, Bureau of Reclamation and others have been mailed to interested people. Exhibits showing by maps, graphs, bulletins and pictures the plans and construction progress have been shown on request at many fairs, conventions and other gatherings, as follows:

Nov. 17-19	1947	Bismarck	Farm Bureau
Dec. 29-30	1947	Minot	N. D. Reclamation Ass'n. Convention.
Feb. 9-13	1948	Minot	Ward County Crop Improvement Ass'n.
Feb. 19-20	1948	New England	Southwestern N. D. Grain Show.
Mar. 8-13	1948	Valley City	Winter Stock Show.
Mar. 25-27	1948	Oklahoma A. & M.College	Rural Life & Educational Conference of 10 Missouri Basin States.
May 13-14	1948	Bismarck	Rural Electric Cooperators Ass'n.
June 13-20	1948	Fargo	Boys State Week.
June 21-25	1948	Dickinson	Annual County Superintendents Conference.
July 13-16	1948	Fessenden	Wells County Free Fair.
July 26-31	1948	Minot	North Dakota State Fair.
Aug. 30-Sep. 4	'48	Fargo	Red River Valley Fair.
Sept. 13-18	1948	Bismarck	State Conservation Show.
Sept. 15-18	1948	Jamestown	N. D. State Dairy Show.
Sept. 24-25	1948	Dickinson	Fall Harvest Festival.
Sept. 24-25	1948	Garrison	Fall Harvest Festival.
Sept. 29-30	1948	Towner	McHenry County Teachers Conference and Young Citizens League.
Oct. 1 -2	1948	Towner	4-H Club Achievement Days.
Oct. 14-16	1948	Devils Lake	Ramsey County Fall Fair.
Oct. 20-22	1948	Grand Forks	N. D. Educational Association.
Nov. 15-16	1948	Bismarck	REA Cooperatives Convention
Nov. 17-19	1948	Oklahoma City	National Reclamation Association.
Dec. 3 -4	1948	Dickinson	State Reclamation Association convention.

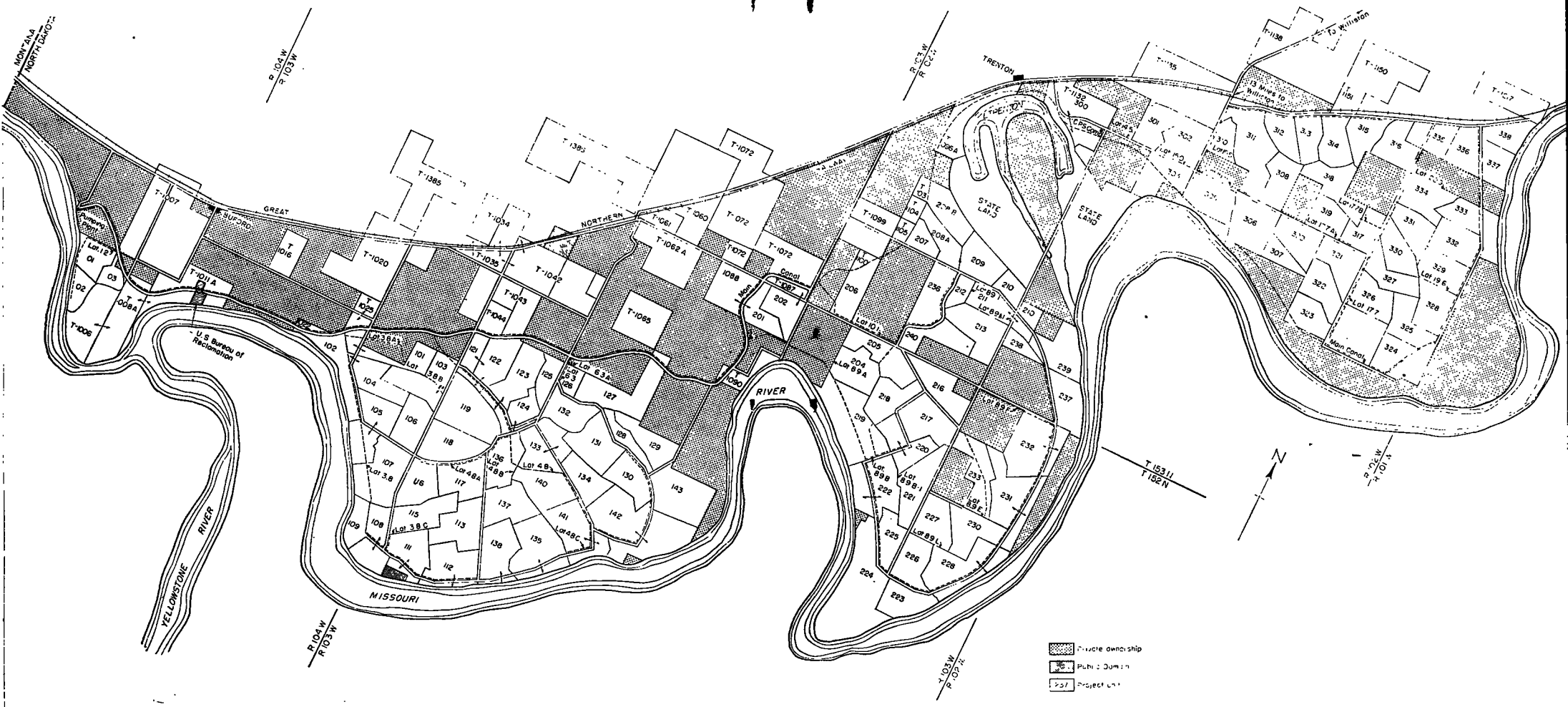


Water Commission Educational Exhibits Show Planned Water Conservation



Figures in columns show length of different periods in years

(See story on page 200)



Partly Constructed Buford-Trenton Irrigation District

Located West of Williston, North Dakota, in Williams Co.

540 YEARS OF DAKOTA WEATHER

George F. Will Found No Pattern for Wet and Dry Cycles in Research Going Back to 1406

Maybe you should throw away your ideas about the weather and then look at the tree rings. You should if you are convinced that the last seven or eight years of good rainfall in North Dakota can't last another season, that a drouth is overdue after so much good fortune. It is known now that in the last 540 years North Dakota once had 39 consecutive wet years. Other periods of continually high moisture in the state during those five and a half centuries stretched into 20 years, 19, 18, 16, 12 and 10 years each before they were broken by dry spells of varying length.

Conversely, we can look back through history as written by the tree rings and learn that the state once had a 16-year unbroken dry spell, that it had three dry periods of 15 years each, that there were three 14-year drouths, four of 13 years each and that the great drouth of the 1930's, that really began in the 1920's, was one of the longest and one of the most severe ever experienced.

If all of this leaves your weather perspective confused, let's put it this way—since 1406 North Dakota has had 302 years capable, as far as moisture is concerned, of producing an average crop or better and 238 years which might have brought less than average. In no year in the last 540 did trees fail to make some growth, as disclosed by the rings, which could be interpreted as meaning there are no years of complete crop failure in the state's known history.

It has been indicated above that these amazing facts are disclosed by tree rings. Where and how? We read about them in a new bulletin called "Tree Ring Studies in North Dakota," published by the North Dakota Agricultural Experiment station but written by George F. Will, Bismarck, N. D., seedsman. With friends in the state historical society and elsewhere, Will has made a distinguished inquiry into past performance of the weather as revealed by tree rings in western North Dakota.

It previously has been established in other areas of the world that tree rings are a reliable source of rainfall history. This is the first time their story in North Dakota has been interpreted and set down as a part of the historical record. Will and others interested in the subject trekked over extensive portions of Missouri valley terrain in their state in search of a living tree of age sufficient to carry them back beyond the 75 years of U. S. weather bureau records which are available at Bismarck. Finally they found one, a burr oak, a few miles north of Bismarck, with a diameter some three to four feet. Cut in 1940 and carted to the laboratory, this ancient oak had 373 growth rings, each showing one year of age, or a total of 373 years. Prying from these rings the rainfall secrets of past centuries requires knowledge and skill but, briefly, the amount of growth shown in each ring is the key to the determination—a wide growth ring denotes heavy rainfall that particular year. A narrow one reveals drouth.

The burr oak's story plotted on a chart was correlated with other information Will gleaned from older timbers, cut by Indians and found by white men on grounds where various Indian villages once flourished in the area. By these means he put together a rainfall picture going back to 1406, nearly five and a half centries.

The longest wet period, 39 years, occurred between 1663 and 1702. A nine-year dry period preceded it, from 1654 to 1663. From 1922 to 1937, an elapse of 15 years, is shown on the Will chart as a dry period. Two other 15-year dry spells are shown, one between 1836 and 1851 and another from 1596 to 1611.

"It becomes perfectly clear," Mr. Will said, "that years of drouth and moisture seem to run in series, sometimes separated by from one to several years of average rainfall."

He adds, however, that it appears impossible to work out any definite pattern as to the number of years in succeeding series. That number varies greatly from one year to a maximum of 39 wet years and 16 dry years. Thus, there are both long periods and short periods, in no particular pattern.—From THE NORTHWEST.

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